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BUILDING PENETRATION PROJECT

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it penetrates the floor, ceiling, and each wall. The total radiant energy within a given room is then the sum of the energies arriving there via the various room-to-room routes within the building. The ratio (in dB) of this total radiant energy density to the energy density incident upon the building is the attenuation, or shielding effectiveness, assigned to that room.

1.3 Outline

Chapter two reviews the search for electrical properties of common building materials, and the mathematical expressions used to compute wall attenuation from these properties. We list the several computer data bases consulted, and note the key word groups that summoned the most useful references. Brief derivations of the computation expressions are given.

In chapter three we present the theory supporting our procedure for computing the attenuation of electromagnetic signals by buildings. It is here that we discuss the assumptions in the formulation of the problem, and limitations imposed by those assumptions.

Descriptions of the data entry programs, data files, and the computation program MASTER constitute chapter four. This material documents the programs and will be of interest mainly to the person wishing to know more about their workings. (User instructions are in the User's Guide, chapter five.)

Chapter five is a guide to the use of the programs. There are instructions on how to become a time-share user, and how to organize data and enter it into the data files. Sample data tabulations are given; also examples of computer printouts illustrating user-computer conversations during data entry.

In chapter six are the results of building attenuation measurements made by NBS at three Army installations. Graphs present the measured data (in dB) versus frequency, and show the effect of the direction of incidence (i.e., location of the launching antenna) on the shielding effectiveness of the structures evaluated. Building floor plans show measurement locations and the placement of launching antennas.

Conclusions and bibliography are chapters seven and eight, respectively. Appendix 9.1 details procedures for making building attenuation measurements and assigning estimated uncertainty. Appendices 9.2-9.7 contains the listings for the five data entry programs, and for the computation program MASTER. Appendix 9.8 is a set of copyable forms for tabulating data to be entered into the data files.

2. SEARCH FOR AND COMPUTATION OF ELECTROMAGNETIC PROPERTIES OF BUILDING MATERIALS

2.1 Introduction

This chapter begins with a description of the literature search for data on the shielding effectiveness of building materials and of buildings themselves. The search was primarily a computer interrogation of several large data bases, although we also perused locally available journals, handbooks, reports and conference proceedings. This extensive search yielded only a few useful references, just one of which furnished us with most of our experimental data on conventional building materials.

Our computations of reflection coefficient and attenuation are based on expressions derived in most introductory texts on electromagnetic fields or electricity and magnetism. We briefly discuss these expressions and their use in obtaining the data in thirteen tables at the end of this chapter.

2.2 The Literature Search

To carry out the computer literature search, we relied on the expertise of Mrs. Victoria R. Schneller of Library Services, Environmental Research Laboratories, National Oceanic and Atmospheric Administration, Boulder, Colorado. The data bases consulted were:

- NTISearch, the computer search service of the National Technical Information Service (NTIS) of the U.S. Dept. of Commerce; accesses all technical abstracts compiled by NTIS; 1964 - present.
- INSPEC (Information Service for Physics, Electrotechnology, and Control); comprises Physics Abstracts, Electrical and Electronic Abstracts, and Computer and Control Abstracts; established by the Institute of Electrical Engineers (England); 1969 - present.
- Smithsonian Scientific Information Exchange (SSIE); 1977 - present.
- COMPENDEX, a data base of the Engineering Index Annual, a yearly publication of engineering and engineering-related abstracts; 1970 - present.
- NSA, the Standards and Specifications data base of the National Standards Association; current standards.
- SCISEARCH, the computer file of the Science Citation Index; 1974 - present.
- DTIC (Defense Technical Information Center); reports on research and development supported by the Department of Defense; 1953-present.

In the search for data on attenuation of electromagnetic waves by building materials, typical key words used were: electrical conductivity, permittivity, building material, construction material, radiofrequency, electromagnetic shielding.

The best report for experimental data on shielding effectiveness of building materials (Brennan, et al. [4]) was obtained from the NTIS data base with the combined key words: electrical properties, electrical conductivity, permittivity, building materials, electromagnetic shielding, radiofrequency, construction. A companion paper (Garrett et al. [5]) was obtained using the same key words but omitting "construction." This selection of keywords retrieved papers on both the direct measurement of electromagnetic attenuation and on measurement of electrical properties from which attenuation could be computed. The DTIC data base search gave the Brennan [4] and Garrett [5] reports in response to the combined key words: building, construction materials, dielectric properties, electrical properties, electrical conductivity. Mrs. Schneller was adept at using different combinations of key words to make an interrogation more specific.

In our search for papers on the attenuation of electromagnetic (EM) waves by buildings (as opposed to building materials), we used key word groups such as: EM field, EM radiation, EM wave absorption, attenuation, shielding, absorption, building, structure, and construction. One of the most useful papers on building attenuation (Smith [3]) had been entered in the INSPEC data base with the key words: electromagnetic compatibility, electromagnetic fields, building, shielding, radiowave propagation. As our search progressed, we found that there was very little data on radiofrequency attenuation by conventional building materials, or even on the electrical properties of such materials.

A computer search based on key words without such qualifiers as "electromagnetic" and "radiofrequency" produces references on the attenuation of nuclear as well as electromagnetic radiation. Many papers retrieved by key words specific to "radiofrequency attenuation by buildings and building materials" concerned structures hardened to electromagnetic interference by specialized construction methods and exotic materials. Often these structures were simply shielded rooms or no more than screened enclosures. Therefore, although our search was extensive, the data we use in our building attenuation computations has come from just a few reports which are identified on the data table for each material.

2.3 Computations

The three types of materials for which we computed shielding properties are dielectrics, metal sheets, and metal meshes. We discuss these computations in that order. All expressions and computed data are in SI units.

Brennan [4] measured the real and imaginary parts of the complex permittivity of common building materials as a function of frequency from 10 Hz to 1 GHz. (Because of the variable sensitivity of the measurement apparatus as the lossiness of the materials varied, measurements often could not be made at each of the intended frequencies.) From these permittivity values, we computed the power reflection coefficient and power attenuation (dB/cm) for each material in decade steps at frequencies from 10 kHz to 10

GHz. If data was not available at a desired frequency, we plotted the given data and then interpolated or extrapolated to obtain the missing point. We now briefly discuss the relations used in our computations.

The electrical characteristics of a lossy, isotropic dielectric are given by its complex permittivity (see any text, such as Johnk [6])

$$\hat{\varepsilon} = \varepsilon' - j\varepsilon'' \tag{2.1}$$

where the real part, ε', contains information on the speed and wavelength of an EM wave in the dielectric (ε' corresponds to the permittivity ε of a lossless dielectric). The imaginary term ε'' accounts for the lossy nature of the dielectric and appears in expressions for the EM wave attenuation due to those losses. Electromagnetic waves are transmitted through a dielectric (lossy or not) with the velocity $v = (\mu\varepsilon)^{-1/2}$, where μ is the permeability of the medium. (The free space values are denoted μ_0, ε_0, and $v = (\mu_0\varepsilon_0)^{-1/2} \cong 3 \times 10^8$ m/s. Air can be considered free space.) In general, ε' and ε'' are functions of the frequency of the EM wave traversing the dielectric, as observed in Brennan's data.

Given two adjoining media of permittivities $\hat{\varepsilon}_1$ and $\hat{\varepsilon}_2$, a wave in medium 1, normally incident on medium 2, has a voltage reflection coefficient ([6], p. 373)

$$\hat{\Gamma} = \frac{\hat{\eta}_2 - \hat{\eta}_1}{\hat{\eta}_2 + \hat{\eta}_1}, \qquad \hat{\eta}_i = \sqrt{\frac{\hat{\mu}_i}{\hat{\varepsilon}_i}} = \text{intrinsic wave impedance.}$$

Because $\mu_2 = \mu_0$ for most building materials in this report, and because medium 1 is air, we can write

$$\hat{\Gamma} = \frac{1 - \sqrt{\hat{\varepsilon}_r}}{1 + \sqrt{\hat{\varepsilon}_r}}, \qquad \hat{\varepsilon}_r = \hat{\varepsilon}_2/\varepsilon_0 = \text{relative permittivity,}$$

where medium 2 is the building. The power reflection coefficient is then

$$\hat{\Gamma}^2 = \left|\frac{1 - \sqrt{\hat{\varepsilon}_r}}{1 + \sqrt{\hat{\varepsilon}_r}}\right|^2 . \tag{2.2}$$

To determine if we must retain $\hat{\varepsilon}_r$ in its complex form, we write

$$\hat{\varepsilon}_r = \frac{1}{\varepsilon_0}(\varepsilon_2' - j\varepsilon_2'') = \varepsilon_r' - j\varepsilon_r''$$

$$= Ae^{-j\theta}\ ; \qquad A = [(\varepsilon_r')^2 + (\varepsilon_r'')^2]^{1/2}\ ; \qquad \theta = \tan^{-1}(\varepsilon_2''/\varepsilon_2'),$$

and so

$$(\hat{\varepsilon}_r)^{1/2} = [(\varepsilon_r')^2 + (\varepsilon_r'')^2]^{1/4}\, e^{-j\theta/2} .$$

For the materials in this report that are low-loss dielectrics ($\varepsilon'' \ll 1$), we neglect ε''_r and approximate $\hat{\varepsilon}_r$ as the real quantity ε_r whose magnitude is ε'_r. This procedure incurs negligible error in the reflection coefficient, the worst case being 2.5% (the 30 kHz ε', ε'' values for moist clay brick) which introduces in eq (2.2) a deviation from the true reflected power of only 0.1 dB. With the above approximation for $\hat{\varepsilon}_r$, our expression for the power reflection coefficient is

$$(\Gamma)^2 = \left(\frac{1 - \sqrt{\varepsilon'_r}}{1 + \sqrt{\varepsilon'_r}}\right)^2 . \tag{2.3}$$

As an EM wave traverses a lossy dielectric, it is attenuated; that is, the wave amplitude decreases with distance. We represent this wave as

$$E_x(z) = E_0\, e^{-\gamma z} = E_0\, e^{-(\alpha + j\beta)z} = E_0\, e^{-\alpha z}\, e^{-j\beta z}$$

where the E-field vector is in the x direction, and the wave propagates along the positive z axis. The exponential factor, $E_0\, e^{-\alpha z}$, represents the wave-amplitude attenuation with distance; α is the attenuation constant. The ratio of amplitudes at points z and $z + \ell$ is

$$\frac{E_0\, e^{-\alpha z}}{E_0\, e^{-\alpha(z + \ell)}} = e^{\alpha\ell} .$$

The attenuation of power density in the wave over the distance ℓ is the square of this ratio and is $e^{2\alpha\ell}$. In decibels, this attenuation is

$$\text{attenuation (dB)} = 10 \log e^{2\alpha\ell} = 10 \times 0.4342 \ln e^{2\alpha\ell} = 8.684\alpha\ell$$

and so

$$\text{attenuation (dB/length)} = 8.684\alpha . \tag{2.4}$$

For a wave of angular frequency ω in a dielectric of complex permittivity $\varepsilon' - j\varepsilon''$ and permeability μ ($= \mu_0$ for dielectrics considered here) we have (Johnk [6], p. 173)

$$\alpha = \frac{\omega\sqrt{\mu\varepsilon'}}{\sqrt{2}} \left[\sqrt{1 + (\varepsilon''/\varepsilon')^2} - 1\right]^{1/2} . \tag{2.5}$$

Brennan has given his values of ε', ε'' as $\varepsilon'/\varepsilon_0$ ($= \varepsilon'_r$) and $\varepsilon''/\varepsilon_0$ ($= \varepsilon''_r$) which he calls dielectric constant ("relative permittivity," in Johnk) and dissipation factor (Johnk's dissipation factor is $\varepsilon''/\varepsilon'$). Writing α in terms of these quantities (where $c \sim 3 \times 10^8$ m/s)

$$\alpha = \frac{\omega\sqrt{\mu_0 \varepsilon'_r \varepsilon_0}}{\sqrt{2}} \left[\sqrt{1 + \left(\frac{\varepsilon''_r}{\varepsilon'_r}\right)^2} - 1\right]^{1/2} = \frac{2\pi f\sqrt{\varepsilon'_r}}{\sqrt{2}\, c} \left[\sqrt{1 + \left(\frac{\varepsilon''_r}{\varepsilon'_r}\right)^2} - 1\right]^{1/2}$$

$$= 1.48 \times 10^{-8}\, f \sqrt{\varepsilon'_r} \left[\sqrt{1 + \left(\frac{\varepsilon''_r}{\varepsilon'_r}\right)^2} - 1\right]^{1/2} . \tag{2.6}$$

In eq (2.5), the factor $\omega\sqrt{\mu\varepsilon} = 2\pi/\lambda$; thus, the dimension of α is $(\text{length})^{-1}$. In metric (S.I.) units, α has the dimension $(\text{meter})^{-1}$, and eq (2.4) will be in dB/m. For our purposes, a more reasonable dimension is dB/cm, and so our values for attenuation were computed from the expression

$$\text{attenuation (dB/cm)} = 0.08684\alpha , \tag{2.7}$$

with α obtained from eq (2.6).

For metals and materials with significant conductivity, σ, the complex permittivity is more appropriately written

$$\hat{\varepsilon} = \varepsilon - j\,\frac{\sigma}{\omega} . \tag{2.8}$$

Following the discussion in Johnk ([6], ch. 3), the corresponding form for α is

$$\alpha = \frac{\omega\sqrt{\mu\varepsilon}}{\sqrt{2}} \left[\sqrt{1 + \left(\frac{\sigma}{\omega\varepsilon}\right)^2} - 1\right]^{1/2} . \tag{2.9}$$

For metals $\sigma \sim 10^7$ mhos/m. Therefore, even at 10 GHz, $\left(\frac{\sigma}{\omega\varepsilon}\right)^2 >> 1$, and α can be written

$$\alpha = \frac{\omega\sqrt{\mu\varepsilon}}{\sqrt{2}} \sqrt{\frac{\sigma}{\omega\varepsilon}} = \sqrt{\frac{\omega\mu\sigma}{2}} = \sqrt{\frac{\omega\mu_r\mu_0\sigma_r\sigma_c}{2}}$$

where μ_r is relative permeability, σ_r is conductivity relative to copper, and σ_c is the conductivity of copper. Substituting $\mu_0 = 4\pi \times 10^{-7}$ farads/meter and $\sigma_c = 5.80 \times 10^7$ mhos/meter, we have

$$\alpha = 15.13\sqrt{f\mu_r\sigma_r}$$

and so

$$\text{attenuation (dB/dm)} = 0.08684\alpha = 1.314\sqrt{f\mu_r\sigma_r} . \tag{2.10}$$

This is the expression in Denny ([7], p. 5-6) for the attenuation of an EM wave traversing a metal sheet 1 cm thick. With eq (2.10) and values for μ_r and σ_r from Table 5-2 in Denny, we computed attenuation values for iron, copper, and aluminum sheets.

For a plane wave normally incident on a surface, the incident, reflected, and transmitted powers are related as

$$P_i = P_r + P_t ,$$

where P_t is the wave power density (w/cm^2) just across the interface and before the wave traverses any of the medium into which it has just passed. Then

$$1 = \frac{P_r}{P_i} + \frac{P_t}{P_i} = (\Gamma_r)^2 + (\Gamma_t)^2$$

and so

$$(\Gamma_r)^2 = 1 - (\Gamma_t)^2 \tag{2.11}$$

where Γ_r and Γ_t are the magnitudes of voltage reflection and transmission coefficients, and their squares are power reflection and transmission coefficients. In Denny ([7], p. 5-5), the reflection loss in dB is given as

$$R = - 10 \log (\Gamma_t)^2 . \tag{2.12}$$

For iron and copper, R values are tabulated in Campi ([8], p. 28), and presented graphically for iron, copper, and aluminum in Denny (p. 5-15). Solving eq (2.12) for $(\Gamma_t)^2$, we have

$$(\Gamma_t)^2 = 10^{-R/10}$$

and we write the power reflection coefficient as

$$(\Gamma_r)^2 = 1 - 10^{-R/10} . \tag{2.13}$$

In Denny [7] and Campi [8], the smallest value of R is 57 dB from 10 kHz to 10 GHz. Therefore, we set the power reflection coefficient to unity over this frequency range for iron, copper and aluminum.

The attenuation of plane EM waves incident normally on metal wire meshes has been computed by Jakubec and Ohta [9], and we give their attenuation values in Tables 2.9 and 2.10 for galvanized steel and copper meshes. Jarva [10] has done some plane wave attenuation computations from the same equations and his values are close to those of Jakubec and Ohta. Some measured attenuations quoted by Jarva support the computed plane wave values. The theoretical expressions employed in both reports are identical, though Jarva gives their derivations.

The mesh attenuation ("insertion loss" in Jarva) computed by Jakubec and Ohta is the same quantity as R in eq (2.12). Using eq (2.13) and attenuation values in Tables 2.9 and 2.10 for R, we see that we are justified in setting the mesh reflection coefficients to unity.

The attenuation and reflection coefficients of a reinforced concrete wall are almost totally due to the reinforcing bars ("rebars") within the concrete. The low shielding effectiveness of concrete alone is seen in our computations of attenuation and reflection coefficients from Brennan's permittivity data for moist mortar (Table 2.2). ("Moist" means the mortar samples were exposed to a saturated atmosphere for one day prior to measurement. Some samples were measured dry: they were baked at 140°F for about 20 hours prior to measurement. However, the moist samples had electrical properties most similar to those of materials in field conditions.) There are many types of concrete reinforcing structures. In some cases, parallel bars without cross members are used; the bars may be horizontal or vertical. When a mesh is

used, the vertical and horizontal bars may have the same spacing and the same bar diameters, or the vertical bars may be heavier and closer together. (Rebar diameters range from 0.95 cm to 6.4 cm.) Thicker walls may have two reinforcing layers: a 20-cm thick concrete wall could have a rebar layer 5 cm in from each face. Thus, knowing only that a concrete wall is reinforced, one cannot be sure of the reinforcing configuration. We use a square mesh to illustrate how rebar shielding may vary with frequency.

The equations presented in references 7, 9, and 10 for the attenuation of plane EM waves by metal screens are based on the transmission of evanescent modes through a waveguide below cutoff. However, reinforcing meshes in concrete have such large openings that cutoff occurs at much lower frequencies, well into the frequency range (10 kHz - 10 GHz) considered in this report. Therefore, we compute the power reflection coefficient for rebar meshes using an equation developed by MacFarlane ([11], p. 1527) for the voltage reflection coefficient for plane waves incident on an infinite parallel-wire grid, the plane of polarization parallel to the grid. Hill and Wait [12] obtain the same expression in their analysis of the scattering of a transient plane wave by a periodic grating. In both these treatments the scattering structure is an infinite set of equally-spaced parallel wires; there are no cross members, unlike the rebar mesh we are considering. However, Hill and Wait [13, 14] show that, for normal incidence, the reflection coefficient obtained by MacFarlane [11] and by Hill and Wait [12] is applicable to scattering from a mesh. For waves at normal incidence, the two crossed grids forming the mesh decouple and interact with the waves as separate, independent parallel-wire grids, each responding only to the E-field component along it. Thus, when the plane of polarization is aligned with one grid, the other has no interaction with the waves and drops out of the analysis. For normal incidence, the mesh field equations obtained by Hill and Wait [13, 14] yield the MacFarlane expression for the reflection coefficient of a parallel-wire grid.

The decoupling of crossed grids of parallel wires is also shown by Kontorovich [15] and Astrakhan [16], but only for the long-wavelength condition ($d \ll \lambda$, d = separation distance between wires of a grid). (Their results cannot be used for wavelengths equal to or less than d, as in our rebar computations.) The analysis contains a term proportional to the electrical resistance between the grids at the points where the wires of one grid are bonded to those of the other. The reflection coefficient for waves at normal incidence does not depend on this term so the grids are, in effect, independent elements of the mesh. For $d \ll \lambda$, MacFarlane's expression for the normal incidence reflection coefficient of a parallel-wire grid reduces to the expression for a mesh [15, 16].

For wavelengths longer than the wire spacing, the power reflection coefficient obtained from MacFarlane for 0° angle-of-incidence is

$$|\hat{\Gamma}_r|^2 = \frac{1}{1 + (\frac{2d}{\lambda})^2 \, [F(\frac{d}{\lambda},0^0) + \ln \frac{d}{2\pi a}]^2} \qquad (2.14)$$

where d = wire spacing, a = wire radius. For $\frac{d}{\lambda} < 1$ (d = wire spacing), $F(\frac{d}{\lambda}, 0^0)$ is a real factor given graphically in references 11 and 12. For short wavelengths ($\frac{d}{\lambda} > 1$), F becomes complex ($\hat{F} = F_r + j\, F_i$), and values for F_r and F_i are also plotted [12]. The power reflection coefficient is then

$$|\hat{\Gamma}_r|^2 = \frac{1}{(1 - \frac{2d}{\lambda} F_i)^2 + (\frac{2d}{\lambda})^2 \, (F_r + \ln \frac{d}{2\pi a})^2} \; . \qquad (2.15)$$

We have used eqs (2.14) and (2.15) to compute the plane-wave power reflection coefficient for a square rebar mesh.

Campi [8] discussed the shielding effectiveness of a rebar mesh having d = 35.6 cm and a = 2.2 cm. We used these dimensions in computing rebar power reflection coefficients from eqs (2.14) and (2.15). The definition of shielding effectiveness (SE) for any shielding material is ([7], p. 5-2)

$$SE = 10 \log \frac{P_1}{P_2} = - 10 \log \frac{P_2}{P_1} = - 10 \log (\Gamma_t)^2 = \text{attenuation (dB)}$$

where (P_1, P_2) = power density (without, with) the shield in place. Then we use eq (2.11) and compute the rebar attenuation from the expression

$$\text{attenuation (dB)} = - 10 \log (\Gamma_t)^2 = - 10 \log (1 - (\Gamma_r)^2). \qquad (2.16)$$

We summarize our computation equations:

- Power reflection coefficient for a dielectric sheet: eq (2.3).
- Power attenuation within a dielectric sheet: eqs (2.6), (2.7).
- Power reflection coefficient for a metal sheet: eq (2.13).
- Power attenuation within a metal sheet: eq (2.10).
- Power reflection coefficient for a metal screen: eq (2.13), using eq (2.12).
- Power reflection coefficient for a rebar mesh: eqs (2.14), (2.15).
- Power attenuation (insertion loss) for a rebar mesh: eq (2.16).

2.4. Uncertainty

For the quantities we have computed (reflection coefficient, attenuation per unit length), we used expressions derived for plane waves at normal incidence. Into these expressions we put measured values for the real and imaginary parts of the complex permittivity. Thus, our computed quantities have uncertainties originating in the measured data we obtained in our literature search. (The reports from which this data was obtained do not give measurement uncertainties.)

However, we must include additional uncertainties in our computed data to account for other factors which influence reflection coefficients and attenuations. For example, although we have assumed normal incidence, waves may be incident at angles from 0° to 90°. A concern? Yes. Fresnel's reflection equations tell us that the reflection coefficient depends on the angle of incidence and the orientation of the plane of polarization with respect to the plane of incidence. The power in a reflected wave may also vary with surface dampness. Another factor adding to the uncertainty in our data is the dependence of wood permittivity on temperature and relative humidity [17], on the angle between the plane of incidence and the wood grain [17], and on chemicals used in treating the wood [18]. There may be other less determinate factors contributing to deviations from our computed data, factors such as manufacturing differences, age of materials, and surface weathering.

Because our computation equations were derived from plane-wave models, they contribute further to the uncertainty of our computed data. As discussed in Denny ([7], section 5.3.2), the reflection coefficient depends on the intrinsic impedance of the incident wave. Plane waves have an intrinsic impedance of about 377 Ω, while waves in the near fields of loop and dipole antennas are not planar and have lower and higher impedances, respectively. These three types of electromagnetic field are all different in their reflection loss versus frequency curves. The reflection loss of high and low impedance fields also depends on the distance of the reflecting surface from the source antenna. Thus, the reflection coefficients we have computed will differ from the true reflection coefficient when the incident wave is something other than plane.

The program MASTER computes only worst-case values for building attenuation and does not do an error analysis. The latter would be of little use considering our lack of detailed information on radiation environments and building structure and contents. However, to acknowledge the "unknowable" uncertainties introduced into our data by the various factors we have discussed, we suggest the following broad uncertainty estimates for the quantities specified:

- 1% - the essentially infinite attenuations and unity reflection coefficients of metal sheets and meshes. This small uncertainty indicates that these materials have a nearly constant effect versus frequency and changing environment.
- 10% - the attenuations of the dielectric materials (e.g., glass, brick, wood). We have assigned this higher uncertainty because these materials, nearly transparent up to microwave frequencies, are the major reason why fields so easily penetrate conventional buildings. Variations in the electrical properties of these materials will alter (though only slightly) the power density of waves passing through them into building interiors.
- 100% - the reflection coefficients of the dielectric materials. This large uncertainty should include most variations in reflection coefficient with angle of incidence, material properties, and environmental conditions.

Note that these uncertainties are in the reflected and attenuated powers and not in the decibel per centimeter values for attenuation.

When we compute the plane-wave shielding effectiveness of a layer of construction material in a wall, the reflection coefficient of the material tells us how much incident power is turned back by the layer, and the attenuation (dB/cm) tells us how much power is absorbed within the material of the layer. (By "power," we mean power density in the wave, e.g., W/cm^2.) Reflection occurs not only at the front, but also at the back surface of the layer. Depending on the reflection coefficient and the attenuation, there may be enough power in the back surface reflection that the succeeding multiple internal reflections within the layer must be considered in determining the net transmission through the layer and the net reflection from the layer. (In this regard, solid metal shields can be neglected. They have such high attenuation that little or no electromagnetic field reaches the back surface of the shield.) Common building materials are dielectrics with very low attenuation and reflection coefficients, and much of the power in the incident wave passes through such a material. Therefore, we must decide if it is sufficient to consider only the front surface reflection, or if the multiple internal reflections within a dielectric layer should be taken into account.

At any instant, the internal reflections within a dielectric sheet produce an infinite series of waves leaving the front and back surfaces of the sheet. The vector addition of the fields in these waves gives the net reflected and transmitted wave. However, to simplify the treatment and still get an estimate of the reflected and transmitted power, we assume constructive interference between all the emerging waves and so add their powers to obtain the total reflected and transmitted power. For low-loss dielectrics, we neglect attenuation within the material. This procedure gives the total reflected power

$$P_r = \frac{2(\Gamma_r)^2}{1 + (\Gamma_r)^2} P_o ,$$

where P_o is the power density of the incident wave, and $(\Gamma_r)^2$ is the power reflection coefficient. The total transmitted power is

$$P_t = \frac{1 - (\Gamma_r)^2}{1 + (\Gamma_r)^2} P_o .$$

For our dielectric materials, $(\Gamma_r)^2 << 1$, and we can write

$$P_r \cong 2 (\Gamma_r)^2 [1 - (\Gamma_r)^2] P_o$$

and

$$P_t \cong [1 - (\Gamma_r)^2]^2 P_o .$$

To first order in $(\Gamma_r)^2$

$$P_r \cong 2(\Gamma_r)^2 P_o$$
$$P_t \cong [1 - 2(\Gamma_r)^2] P_o. \qquad (2.17)$$

For a single surface (i.e., ignoring multiple reflections caused by a second surface), the reflected and transmitted powers are obtained by inspection

$$P_r = (\Gamma_r)^2 P_o$$
$$P_t = [1 - (\Gamma_r)^2] P_o . \qquad (2.18)$$

Even though the pairs of eqs (2.17) and (2.18) differ slightly in form, $(\Gamma_r)^2$ is so small that the effect of a second surface on P_r is generally negligible; and, in both cases, P_t is so slightly different from P_o that, again, we ignore the effect of a second surface. Therefore, we consider only a single reflecting/transmitting surface for each material in a building wall. Any error incurred by this assumption will be covered by the 100% uncertainty we have assigned to the reflection coefficients for dielectric construction materials.

2.5 Reflection Coefficient and Attenuation Data for Selected Building Materials

The data in the following fourteen tables has been entered into the data file MATTER and is ready for use in the building attenuation computations performed by the program MASTER. We preface the tables with these comments:

- The null material (M01) must be used as the "material" of an open doorway or an open, unscreened window. As a formality whenever material M01 is needed, the user must enter into the data file HOLES a material thickness T of 1 cm.
- Dry wall (wall board, sheet rock) is mainly plaster of Paris (material M03).
- The word "moist" (materials M02, M03, M06, M07) does not imply "soft", "fresh", or "uncured", but only that material samples measured after 24 hours in a saturated atmosphere (as opposed to samples baked dry) had electrical properties more similar to the same materials in field conditions.
- "Clay brick" (material M06) refers to the brick commonly used in homes and buildings.
- All common lumber and plywood have a very low reflection coefficient and attenuation (dB/cm). Therefore, the material data tables contain only Douglas fir and fir plywood as representative types to be used for any wood or plywood the user may encounter as building materials.
- Because the attenuation by a metal screen (materials M09, M10, M11) is actually an insertion loss given in dB instead of dB/cm, the mesh thickness is not required. However, as a formality to satisfy the computation program MASTER, the user must enter into the data file BxxxxxT a mesh thickness T of 1 cm.
- The assigned uncertainties are in the transmitted and reflected powers, and must not be applied to the attenuation in dB/cm.

Table 2.1: Null Material (Mat'l. No. M01) (Thickness T = 1 cm)

Frequency (Hz)	Attenuation (dB/cm)	Power reflection coefficient
10^4	0	0
10^5	0	0
10^6	0	0
10^7	0	0
10^8	0	0
10^9	0	0
10^{10}	0	0

Material: Fictitious; a formality, required by the program MASTER, used to represent the "material" of passageways, open doorways, and open, unscreened windows.

Table 2.2: Moist Mortar (Mat'l. No. M02)

Frequency (Hz)	Attenuation (dB/cm)	Power reflection coefficient
10^4	1.22×10^{-6}	0.23
10^5	7.54×10^{-6}	0.17
10^6	3.55×10^{-6}	0.16
10^7	7.70×10^{-5}	0.13
10^8	1.89×10^{-3}	0.10
10^9	1.12×10^{-2}	0.055
10^{10}	0.13*	0.03*

Material: Moist mortar; 6.5 gal. H_2O/94 lb. sack of cement; Portland cement-aggregate ratio: 1/3.

Data Source: Brennan [4].

Assigned Uncertainty: Attenuation, 10%; reflection coefficient, 100%.

*Extrapolated.

Table 2.3: Plaster of Paris (Mat'l. No. M03)

Frequency (Hz)	Attenuation (dB/cm)	Power reflection coefficient
10^4	2.98×10^{-7}	0.063
10^5	4.41×10^{-7}	0.059
10^6	1.50×10^{-6}	0.084
10^7	2.58×10^{-6}	0.076
10^8	4.84×10^{-5}	0.063
10^9	7.6×10^{-4}	0.007
10^{10}	7.6×10^{-3}*	0.007*

Material: Moist plaster of Paris (main component of dry wall).

Data Source: Brennan [4].

Assigned Uncertainty: Attenuation, 10%; reflection coefficient, 100%.

*Extrapolated.

Table 2.4: Douglas Fir (Mat'l. No. M04)

Frequency (Hz)	Attenuation (dB/cm)	Power reflection coefficient
10^4	4.28×10^{-7}	0.047
10^5	2.59×10^{-6}	0.041
10^6	4.35×10^{-6}	0.063
10^7	1.10×10^{-4}	0.050
10^8	1.98×10^{-3}	0.025
10^9	2.0×10^{-2}	0.019
10^{10}	0.22*	0.014*

Material: Douglas fir.

Data Source: Brennan [4].

Assigned Uncertainty: Attenuation, 10%; reflection coefficient, 100%.

*Extrapolated.

Table 2.5: Fir Plywood (Mat'l. No. M05)

Frequency (Hz)	Attenuation (dB/cm)	Power reflection coefficient
10^4	1.15×10^{-6}	0.068
10^5	6.77×10^{-6}	0.048
10^6	8.31×10^{-6}	0.074
10^7	1.24×10^{-4}	0.036
10^8	2.15×10^{-3}	0.014
10^9	2.6×10^{-2}	0.013
10^{10}	0.30*	0.010*

Material: Fir plywood.

Data Source: Brennan [4].

Assigned Uncertainty: Attenuation, 10%; reflection coefficient, 100%.

*Extrapolated.

Table 2.6: Clay Brick (Mat'l. No. M06)

Frequency (Hz)	Attenuation (dB/cm)	Power reflection coefficient
10^4	2.20×10^{-6}	0.13
10^5	1.02×10^{-5}	0.072
10^6	1.4×10^{-4}*	0.051*
10^7	2.5×10^{-3}*	0.029*
10^8	5.72×10^{-3}	0.014
10^9	5.72×10^{-3}	0.014
10^{10}	5.7×10^{-3}*	0.014*

Material: Moist clay brick.

Data Source: Brennan [4].

Assigned Uncertainty: Attenuation, 10%; reflection coefficient, 100%.

*Interpolated or extrapolated.

Table 2.7: Cinder Block (Mat'l. No. M07)

Frequency (Hz)	Attenuation (dB/cm)	Power reflection coefficient
10^4	1.74×10^{-6}	0.17
10^5	8.30×10^{-6}	0.14
10^6	3.85×10^{-5}	0.13
10^7	2.82×10^{-4}	0.055
10^8	5.71×10^{-3}	0.013
10^9	5.71×10^{-2}	0.013
10^{10}	0.57*	0.013*

Material: Moist cinder block (Featherlite).

Data Source: Brennan [4].

Assigned Uncertainty: Attenuation, 10%; reflection coefficient, 100%.

*Extrapolated.

Table 2.8: Glass (Mat'l. No. M08)

Frequency (Hz)	Attenuation (dB/cm)	Power reflection coefficient
10^4	1.36×10^{-8}	0.20
10^5	2.28×10^{-7}	0.18
10^6	2.88×10^{-6}	0.19
10^7	3.95×10^{-5}	0.19
10^8	4.00×10^{-4}	0.15
10^9	5.04×10^{-3}	0.082
10^{10}	7.1×10^{-2}*	0.015*

Material: Glass (type not specified). We assume "window glass" because the Brennan report concerns only building materials.

Data Source: Brennan [4].

Assigned Uncertainty: Attenuation, 10%; reflection coefficient, 100%.

*Extrapolated.

Table 2.9: Steel Mesh (Mat'l. No. M09) (Thickness T = 1 cm)

Frequency (Hz)	Attenuation (dB/cm)	Power reflection coefficient
10^4	141.0*	1.0
10^5	132.0*	1.0
10^6	114.0	1.0
10^7	94.1	1.0
10^8	44.0*	1.0
10^9	54.1	1.0
10^{10}	34.0*	1.0

Material: Galvanized steel mesh (24 × 24).

Data Source: Jakubec and Ohta [9].

Assigned Uncertainty: Attenuation, 1%; reflection coefficient, 1%.

*Interpolated or extrapolated.

Table 2.10: Copper Mesh (Mat'l. No. M10) (Thickness T = 1 cm)

Frequency (Hz)	Attenuation (dB/cm)	Power reflection coefficient
10^4	106.0*	1.0
10^5	110.0*	1.0
10^6	104.2	1.0
10^7	88.0	1.0
10^8	68.0*	1.0
10^9	48.4	1.0
10^{10}	28.0*	1.0

Material: Copper mesh (20 × 20).

Data Source: Jakubec and Ohta [9].

Assigned Uncertainty: Attenuation, 1%; reflection coefficient, 1%.

*Interpolated or extrapolated.

Table 2.11: Reinforcing Bar Mesh (Mat'l. No. M11) (Thickness T = 1 cm)

Frequency (Hz)	Attenuation (dB/cm)	Power reflection coefficient
10^4	1000.0*	1.0
10^5	1000.0*	1.0
10^6	1000.0*	1.0
10^7	1000.0*	1.0
10^8	12.2	0.94
10^9	0.22	0.05
10^{10}	0	0

Material: Reinforcing bar square mesh; 35.6 cm on centers; bar diameter = 4.3 cm.

Data Source: Hill and Wait [12]; MacFarlane [11].

Assigned Uncertainty: Attenuation, 1%; reflection coefficient, 1%.

*To represent infinite attenuation as computed from unity power reflection coefficient.

Table 2.12: Iron Sheet (Mat'l. No. M12)

Frequency (Hz)	Attenuation (dB/cm)	Power reflection coefficient
10^4	$1.71 \times 10^{+3}$	1.0
10^5	$5.42 \times 10^{+3}$	1.0
10^6	$1.43 \times 10^{+4}$	1.0
10^7	$3.83 \times 10^{+4}$	1.0
10^8	$5.42 \times 10^{+4}$	1.0
10^9	$1.21 \times 10^{+5}$	1.0
10^{10}	$5.42 \times 10^{+4}$	1.0

Material: Iron sheet.

Data Source: Denny [7]; Campi [8].

Assigned Uncertainty: Attenuation, 1%; reflection coefficient, 1%.

Table 2.13: Aluminum Sheet (Mat'l. No. M13)

Frequency (Hz)	Attenuation (dB/cm)	Power reflection coefficient
10^4	$1.03 \times 10^{+2}$	1.0
10^5	$3.24 \times 10^{+2}$	1.0
10^6	$1.03 \times 10^{+3}$	1.0
10^7	$3.24 \times 10^{+3}$	1.0
10^8	$1.03 \times 10^{+4}$	1.0
10^9	$3.24 \times 10^{+4}$	1.0
10^{10}	$1.03 \times 10^{+5}$	1.0

Material: Aluminum sheet.

Data Source: Denny [7]; Campi [8].

Assigned Uncertainty: Attenuation, 1%; reflection coefficient, 1%.

Table 2.14: Copper Sheet (Mat'l. No. M14)

Frequency (Hz)	Attenuation (dB/cm)	Power reflection coefficient
10^4	$1.31 \times 10^{+2}$	1.0
10^5	$4.16 \times 10^{+2}$	1.0
10^6	$1.31 \times 10^{+3}$	1.0
10^7	$4.16 \times 10^{+3}$	1.0
10^8	$1.31 \times 10^{+4}$	1.0
10^9	$4.16 \times 10^{+4}$	1.0
10^{10}	$1.31 \times 10^{+5}$	1.0

Material: Copper sheet.

Data Source: Denny [7]; Campi [8].

Assigned Uncertainty: Attenuation, 1%; reflection coefficient, 1%.

3. CALCULATION FOR BUILDING SHIELDING EFFECTIVENESS -- THEORY

3.1 Introduction

This chapter discusses the theoretical basis for the calculation of building shielding effectiveness. After this introduction, there are four sections which consider a definition of the problem, the input data that will be used in the calculation, the actual mathematical approach used to calculate building shielding effectiveness, and window and door resonances.

3.2 Definition of Problem

The purpose of this project is to calculate how well a building shields from external electromagnetic interference. Automated on a computer, this calculation is to provide a worst case estimate of the electromagnetic power level appearing in a room of a building given the physical construction and dimensions of the building and given a known external incident field strength. The estimate must be useful over a wide frequency range (10 kHz - 10 GHz) and must be general enough so that it can be used effectively on several hundred differently constructed buildings.

3.3 Input Data Available

In any given calculation of electromagnetic shielding effectiveness, it is always desirable to have sufficient, high quality data to make the calculation yield a precision result. For example, the best data possible would be to actually measure a given building for electromagnetic shielding effectiveness using external antennas to launch a known field and calibrated antennas to measure the field inside of the building. The calculation would then be trivial -- the ratio of the launched field versus the measured internal field would be calculated directly. In fact such measurements have been performed and have yielded excellent results. Such field measurements made during this project are detailed in Chapter 6 of this report.

Direct measurements of electromagnetic shielding effectiveness, although highly effective in characterizing a building, have the disadvantage of being time consuming and expensive. A typical field measurement of one building at one site can take three or four engineers from three to five days to complete. When three to five hundred buildings are contemplated, it clearly becomes difficult to obtain actual field data in an efficient manner. Another approach is to take "less expensive" data that can be used in a model that will give an estimate of the shielding effectiveness. This estimate may not be as accurate as actual field data, but it may give sufficient accuracy to make a cost effective analysis of a building. This section describes the data that will be used in the estimation of building measurements.

For a particular calculation for a given building, the input data is restricted to the actual physical construction details of the building. The input data include: 1) building construction materials; 2) the dimensions of the building; and, 3) the construction practices involved in erecting the building. These three categories of data are to be obtained either from building drawings which were used in the original construction and which have been properly updated with modifications, or by actual physical measurements on the building itself. Although it will be less accurate than direct EMI measurements, the estimate of EM shielding effectiveness based on the physical construction of the building should be sufficiently accurate to determine the suitability of most buildings for electromagnetic shielding. In the few cases where the calculated estimate is perhaps ambiguous, actual EMI measurements could be performed. A test plan for field measurements of EMI for these marginal cases is presented in the appendix. Details and methods for gathering the actual physical data and putting it into a form usable in the present computer model will be presented in Chapter 5, "User's guide to the computer programs."

3.4 Approach

To estimate the electromagnetic shielding ability of a building, the following approach is taken. The energy entering the building from external sources is calculated for each room by considering the direct penetration through all the walls, windows and doors. The energy in each room can then go to the other rooms through internal walls and doors, as well as going back outside. As the energy continues to flow through each room, the power in each room reaches a steady state condition corresponding to a balance between the energy flowing in and out. To calculate the steady state power level, it is necessary to first consider a model that will describe the flow of the electromagnetic energy through the building. The assumptions in this model listed in figure 3.1, and graphically shown in figure 3.2, must also be considered.

The first assumption is that the input electromagnetic radiation will consist of plane waves with normal incidence on a particular external wall. The calculation will be repeated five times corresponding to the four horizontal incidence directions (i.e., North, South, East and West) and the one vertical direction (i.e., from above). The sixth direction, from below or through the ground will be ignored.

The first assumption is used to calculate the power entering a room through an external wall from the outside. If the energy density of the incident field is represented by P with units of joules/m^3, the energy, E_{IN}, entering a room in one second will be

$$E_{IN} = tPcA \tag{3.1}$$

where t is the transmission coefficient/unit length of the external wall and c is the speed of the electromagnetic radiation (the speed of light). The term A represents the area of the external wall. If the room has a door in the wall, eq (3.1) becomes

$$E_1 = t_1 P c A_1 + t_2 P c A_2 \tag{3.2}$$

where t_2 and A_2 represent the transmission coefficient and area of the door.

The second assumption is that there will be no refraction by the building of the incident plane wave, and the incoming energy will only enter those walls which are normal to the incoming radiation. This effect can also be considered a shadowing effect.

The third assumption deals with multiple layers on a wall. It states that the composite transmission coefficient of a multi-layered wall will be represented as the product of the individual transmission coefficients of the layers or

$$t_{composite} = \Pi t_i \tag{3.3}$$

where the t_i's represent the transmission coefficient of the layers. This is really a simplification that ignores internal reflections in the walls and the related interference effects.

The fourth assumption considers how the energy in a room scatters and flows to the other rooms. This assumption states that the energy in a room will be isotropically scattered in all directions. Hence, in a cubic room where the four walls, the floors and ceilings all have the same area, one sixth of the room's energy would hit each of the six surfaces equally.

To find the transmission of energy from one room to another, consider figure 3.3, a building with two rooms. The first room has an energy density N, (J/m^3). From assumption four, this energy is isotropically scattered in all directions equally. The fraction, F, of the energy scattered against the internal wall will be

$$F = \frac{A_w}{A_{1,total}} \quad , \tag{3.4}$$

where A_w is the internal wall area, and $A_{1,total}$ is the total area of the walls, floor, and ceiling in room 1. The energy that is transmitted per second from room 1 to room 2 will be

$$E_{1,2} = t\, N_1\, c\, F\, A_w \tag{3.5}$$

where the subscripts on E represent flow from room 1 to room 2. Substituting for F yields

$$E_{1,2} = t\, N_1\, c\, \frac{A_w^{\ 2}}{A_{1,t}} \quad . \tag{3.6}$$

Note that the energy flowing from room 2 to room 1 will be

$$E_{2,1} = t\, N_2\, c\, \frac{A_w^{\ 2}}{A_{2,t}} \quad . \tag{3.7}$$

which differs from eq (3.6) because the room 2 energy density, N_2, is different and the total area of room 2, $A_{2,t}$, is different. Using eqs (3.1) and (3.6) the energy transmitted between the outside to the

rooms, and from room to room, can be described. We must now consider absorption and reflection for the walls, which brings us to the fifth assumption.

The fifth assumption states that wall reflections will be ignored unless the frequency of the radiation is near a resonance of the room. Outside of resonance, any radiation hitting a wall that is not transmitted will be absorbed or

$$D = 1 - t \tag{3.8}$$

where D is the absorption coefficient and t is the transmission coefficient. When the frequency is near a room resonance then reflections will be accounted for and

$$D = 1 - t - r \tag{3.9}$$

where r now represents the reflection coefficient.

The frequency range of a room resonance will be between F_{low} and F_{high} where

$$F_{low} = \frac{c}{2} \left[\frac{1}{B^2} + \frac{1}{C^2}\right]^{\frac{1}{2}}$$

and

$$F_{high} = \frac{c}{2} \left[\left(\frac{3}{A}\right)^2 + \left(\frac{3}{B}\right)^2 + \left(\frac{3}{C}\right)^2\right]^{\frac{1}{2}}$$

where A, B, and C represent the three dimensions of the room with B and C being the longest. Experience indicates that modes above 3, 3, 3 do not contribute significantly to resonance fields in a room. Therefore, these higher order modes are ignored in this model.

Note that in resonance, eq (3.9) reduces the absorption coefficient and hence reduces the effective energy loss from the room. This is equivalent to reflecting it back into the room.

The energy losses in a room can now be found by replacing t in eq (3.7) with D from either eq (3.8) or (3.9) and obtaining

$$L_{1,2} = D\, N_1\, c\, \frac{A_w^{\,2}}{A_{1,t}} \tag{3.10}$$

where L represents the energy lost from the room.

The sixth assumption states that in a calculation of the steady state energy distribution within a structure, the E or H field is computed by assuming free space impedance. To calculate the steady state energy in a room, we first write down an equation which represents the change in energy with respect to time or

$$\frac{dN_1V_1}{dt} = G - L \tag{3.11}$$

where V_1 is the volume of the room and G represents the sum of all the energy gains into the room as represented by either eqs (3.2), (3.6) or (3.7). Note that a room can gain energy from the outside (eq (3.2)) and from other rooms (eqs (3.6) or (3.7)). In eq (3.11), L represents the energy lost from a room and is taken from eq (3.6) for energy transmitted out or eq (3.10) for energy absorbed in a wall. Note that for M rooms, there will be M eq (3.11)'s.

For the steady state condition eq (3.11) will equal zero. Hence there will be M eq (3.11)'s equal to zero. Since the M eq (3.11)'s have only M unknowns (the M energy levels in each room) there will be a unique solution which gives the M energy levels in the rooms.

3.5 Input Resonances

Room resonances have already been considered by adding the reflection coefficients of a wall in eq (3.9). An additional input resonance is also considered for windows or doors in the following manner. If a window or door has a metal frame, then the transmission coefficient for the window is increased by 20 dB if the incoming frequency is near a window resonance. The frequency range for a window resonance will be defined as lying between F_{low} and F_{high} where

$$F_{low} = \frac{c}{2B}$$

$$F_{high} = \frac{c}{2} \left[\left(\frac{3}{B}\right)^2 + \left(\frac{3}{A}\right)^2 \right]^{\frac{1}{2}}$$

where A and B are the smallest and largest dimensions of the windows. Note that resonances above mode 3,3 are ignored.

1. Plane wave incident on surface(s) of structure. Use attenuation of wall material(s) to calculate transmission.
2. Ignore external refraction by building.
3. Disregard multiple internal reflections within wall(s).
4. Energy reaching inside of structure is scattered isotropically. Energy leaves structure through all available surfaces.
5. Reflections within room from walls, ceiling, etc., are only considered if frequency is near room resonance(s). Only first three resonant modes are considered. Input coupling resonances are also considered for metal door and window frames by increasing transmission by 20 dB near resonant frequency.
6. Steady state energy distribution within structure allows E or H field to be computed (free space impedance assumed).

FIGURE 3.1 ASSUMPTIONS USED IN MODEL.

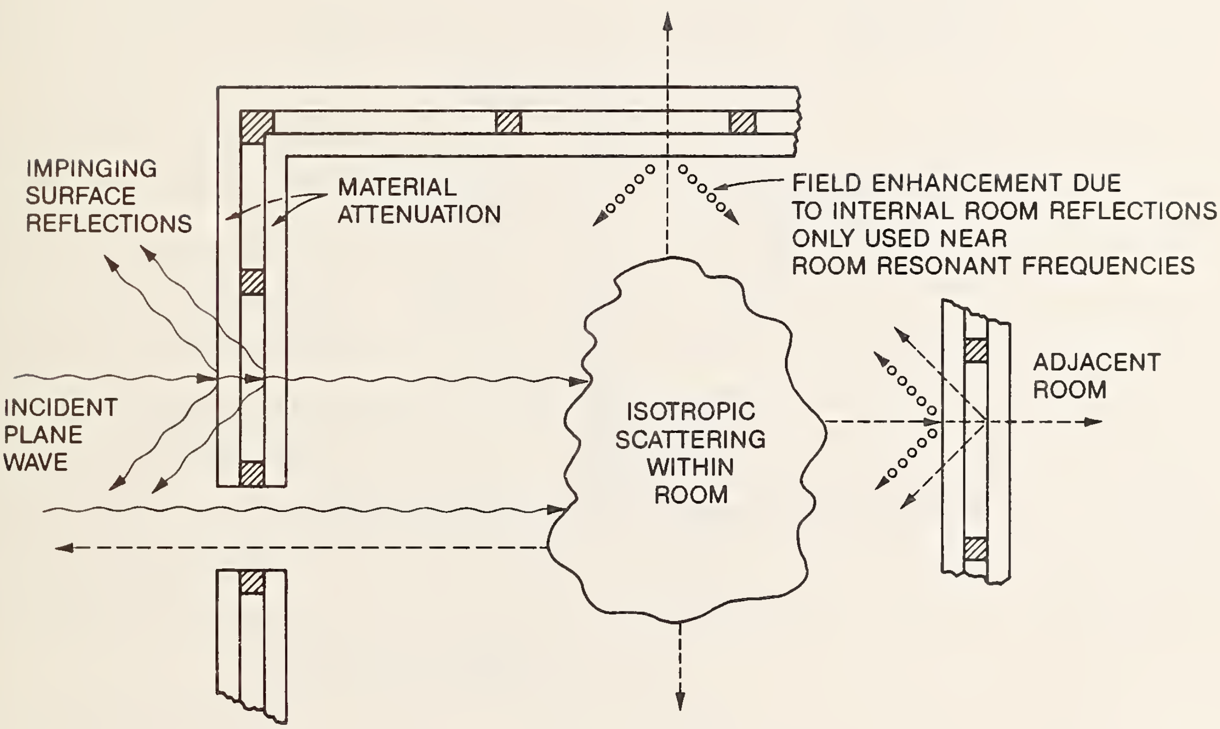


FIGURE 3.2 ENERGY FLOW ANALYSIS.

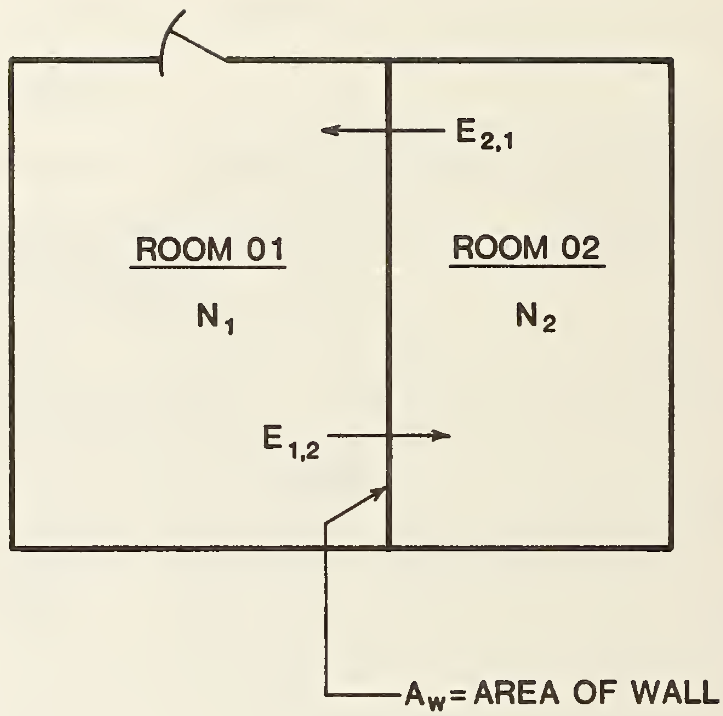


FIGURE 3.3 ENERGY FLOW BETWEEN TWO ROOMS.

4. COMPUTER PROGRAM DESCRIPTIONS

4.1 Introduction

This chapter provides a description of the computer programs used in the calculation of electromagnetic shielding effectiveness of buildings. The presentation is aimed at the programmer level. The intention is to provide information about the programming methods used in the present calculations. Information on how to use the programs is provided in Chapter 5, entitled, "User's guide to each of the programs." This chapter, besides the introduction, has four additional sections which describe the field calculation program, the data entry programs, the data structures used in the programs, and, finally, a more detailed description of the programs and their subroutines listed in alphabetical order. This last section also highlights those variables which are important to the understanding of the programs.

The project's purpose is to calculate the maximum electromagnetic field possible in each room of a building from a plane wave impinging directly upon the walls of the building given the dimensions of the building and the materials used in its construction. The program accesses permanent data files which describe the dimensions and material of each layer of each wall, door, and window of the building. These data files are created for each building using separate programs. The program also accesses a previously stored data file which contains the attenuation and reflection coefficients of different construction materials. This data is then used to calculate a transmission coefficient and an absorption coefficient for each wall considering the properties of each layer and each opening. Using these coefficients an energy flow into each room from the outside and from the other rooms is calculated. The energy flowing back out of the building is also then calculated. A steady state energy balance is then assumed for all the rooms, and from this steady state assumption, the energy level in each room is calculated.

4.2 General Description of the Field Calculation Program

A procedure file FIELD gets the main program from mass storage and runs it. The main program MASTER sets up the common blocks and then calls each of the subroutines. Five subroutines (LMATTER, LFREQ, LWALL, LTYPE, and LHOLE) load data from permanent storage into arrays which are accessed by the program when the data is needed for computation. The subroutine LTDB calculates the attenuation and area of each type opening, layer by layer, and loads it into the TDB array.

The CFACTOR subroutine calculates transmission factors of each wall and loads them into the ROOM array. These transmission factors determine the transmission between each room and its adjacent volume, which may be another room or the exterior of the building. The calculation is performed for each material layer of each wall and of each opening in the wall. Note: in this discussion "wall" also means floor and ceiling. These calculations are done sequentially and accumulated as the data for each layer of each opening is accessed in the data files.

The DFACTOR subroutine calculates the absorption factor of each wall and loads them into the DDABS array. In this calculation the absorption is taken as one minus the transmission and minus the reflection. The reflection coefficient is included if a resonance condition is met.

The subroutine ECALC is used to calculate the steady state energy in the rooms. It starts by calling the subroutine SETUP which takes the transmission coefficients from the ROOM arrays and combines them with the absorption coefficients in the DDABS array to produce the proper relationships for energy flow between the rooms and the outside. These linear relationships are put into the TMAT array. The subroutine ECALC then calculates the steady state energy balance in the rooms using the subroutine DETERM. The subroutines RESOND and RESONW calculate resonance conditions for apertures and rooms.

Several subroutines with a "P" prefix print results or file contents. For example, PHOLE, PTYPE, PWALL print the data contained in the data files and the corresponding arrays.

4.3 General Description of the Data Entry Programs

There are five data entry programs: three to store data describing buildings, one to store frequencies, and one to store properties of construction. The three which store the building data are SWALLS, STYPES, and SHOLES; the material properties are stored by SMATDB. The frequencies are stored using SFREQ. These are source code files; the user will only see the equivalent procedure files HSTORE, WSTORE, TSTORE, FSTORE and MSTORE which call and run the compiled binary equivalents of these source files.

All three building description programs use the same interactive format. Each asks the user for a building identifier which can be as many as five characters long. That building identifier is used to create the names for the permanent data files needed for each building. For example, if the building identifier were "A125" then three permanent files would be named and created: "BA125T", "BA125W", "BA125F", and "BA125H". The suffixes "T", "W", "F", and "H" refer to "Type" data, "Wall" data, "Frequency" data and "Hole" data, respectively.

The material data storage program, also interactive, stores attenuation and reflection coefficient data for different frequencies in a permanent file called MATTER. This program will only be used for adding new construction materials to the material data base.

4.4 Data Structures Used in the Programs

Arrays and Variables:

The following gives a brief description of the variables used in the common blocks.

<u>Hole Variables</u>

HMAX: maximum size of hole array. Initially set at 35.

HOLE (1-HMAX, 1-4): Array containing room and aperture ID.

HOLE (x,1): "Direction" part of room identification.

HOLE (x,2): "From room" part of room identification.

HOLE (x,3): "To room" part of room identification.

HOLE (x,4): "Aperture ID".

HTOT: A numeric variable containing the total number of lines in the "hole" data file.

HERR: A numeric variable used to indicate a file handling error and used in the WARNING and ERROR subroutines to trigger a message to the operator.

Type Variables

TMAX: Maximum size of TYPE and TDIM arrays. Initially set at 35.

TYPE (1-TMAX, 1-4): Character array containing dimensions and material of each layer of each type of door or window.

TYPE (x,1): Identification of type, e.g., "WA" meaning window "A" and "DB" meaning door B.

TYPE (x,2): Material of layer, e.g., "MØ3" meaning Material #3.

TYPE (x,3): Material of the frame, e.g., "MØ5" meaning Material #5.

TDIM (1-TMAX, 1-4): Numeric array containing dimensions of each door or window. Used in parallel with TYPE array.

TDIM (x,1): Height of opening in meters.

TDIM (x,2): Width of opening in meters.

TDIM (x,3): Thickness of layer in centimeters.

TDIM (x,4): Distance of opening above floor in meters.

TDB1 (1-TMAX): Character array containing opening identification. Used in parallel with TDB2 array.

TDB1 (x): Opening identification, e.g., "WA".

TDB2 (1-TMAX, 1-2): Numeric array containing attenuation and area of opening. Used in parallel with TDB1 array.

TDB2 (x,1): Attenuation of opening.

TDB2 (x,2): Area of opening in square meters.

TTOT: A numeric variable containing the number of lines in the "Type" data files.

TDBTOT: A numeric variable representing the total number of lines in the TDB1 and TDB2 data arrays.

TERR: A numeric variable used to indicate an error and used in the WARNING and ERROR subroutines to trigger a message to the operator.

Material Variables

MAT (1-1ØØ): Contains material identifiers such as "MØ1", "MØ2", ..."M99".

MATDESC (1-1ØØ): Contains description of each material. (7Ø characters each).

MFREQ (1-1ØØ, 1-7) real array: Contains 7 frequencies at which the property data exists.

MATTEN (1-1ØØ, 1-7): Contains 7 attenuation values for each material.

QA (1-1ØØ): Contains a quality factor for each material.

MRCOEF (1-1ØØ, 1-7): Contains 7 reflection coefficients for each material.

QR (1-1ØØ): Contains a reflection coefficient quality factor for each material.

Room Variables

DDABS (1-RMAX + 6, 1-RMAX + 6): This numeric array contains the absorption coefficients of the walls in each room.

ENERGY (1-RMAX): This numeric array contains the results of the energy balance calculations and contains the energy in each room.

POWER (1-6): This numeric array contains the power entering the building from each of the six outside directions: North, East, South, West, Top, Bottom.

RAREA (1-RMAX): Array containing surface area of each room.

RMAX: This numeric variable sets the maximum number of rooms that the program can handle. Initially set for 2Ø for simplicity of the display subroutine when printing on 8Ø column paper.

ROOM (1-RMAX + 6, 1-RMAX + 6): This numeric array is used for the transmission factors between room and room, and between room and the outside world.

TMAT (1-RMAX + 6, 1-RMAX + 6): This numeric array is the matrix that contains the linear relationships of energy flow between the rooms. It is a combination of information from the ROOM array and the DDABS array, and is created using the subroutine SETUP.

Wall Variables

WMAX: Maximum size of wall arrays. Initially set to 75.

WALL (1-WMAX, 1-4): Character array containing wall identifiers and material identification.

WALL (x,1): Direction--one of three wall identifiers.

WALL (x,2): From room--one of three wall identifiers.

Wall (x,3): To room--one of three wall identifiers.

WDIM (1-WMAX, 1-3): Numeric array containing wall dimensions.

WDIM (x,1): Height in meters.

WDIM (x,2): Width in meters.

WDIM (x,3): Layer thickness in centimeters.

WTOT: A numeric variable containing the number of lines in the Wall data files.

WERR: A numeric variable used to indicate a file handling error and used in the WARNING and ERROR subroutines to trigger a message to the operator.

Miscellaneous Variables

BLDG: This character variable contains the building identifier. It is combined with other strings to identify the various data files associated with that building.

DREFL: This variable contains the reflection coefficient for a wall. If the frequency is not near a room resonance, DREFL is set to zero.

DREFLW: This variable is used to calculate window input resonances. If the frequency is near a window resonance then DREFLW is set to 20 dB. Otherwise, DREFLW is zero.

FMAX: Maximum number of frequency values in FREQA array. Initially set at 50.

FREQ: Frequency in hertz.

FREQA (1-FMAX): A numeric array containing frequencies for calculations.

AFLAG: A number between Ø and 1ØØ which determines how much of the quality factor is applied to the attenuation value.

RFLAG: A number between Ø and 1ØØ which determines how much of the quality factor is applied to the reflection coefficient value.

Labeled Common Blocks:

This section lists variables transmitted by each labeled common block along with the subroutines using the block.

INITILC: BLDG

Common to MASTER, CFACTOR, LHOLE, LTDB, LTYPE, LWALL, PROOM, PPWR, PTMAT, DFACTOR, PDDABS, PPWR2, SPWR, RESONW, RESOND, LFREQ

INITILN: FREQ, QUALITY, AFLAG, RFLAG, FREQA (FMAX), FERR, FTOT

Common to MASTER, CFACTOR, LHOLE, LTDB, LTYPE, LWALL, PROOM, PPWR, RESOND, RESONW, PPWR2, PDDABS, PTMAT, DFACTOR, SPWR, LFREQ

HOLEC: HOLE (HMAX, 4)

Common to MASTER, CFACTOR, LHOLE, DFACTOR, PHOLE

HOLEN: HTOT, HERR

Common to MASTER, CFACTOR, LHOLE, DFACTOR, PHOLE

MATC: MAT (MMAX), MATDESC (MMAX)

Common to MASTER, ATTEN, LMATTER, RCOEF, RESONW

MAT: TMAT (RMAX, RMAX), ENERGY (RMAX), POWER (6), FTIME, SWR (RMAX, 6), IDIR

Common to MASTER, SETUP, ECALC, PPWR, PTMAT, PPWR2, SPWR, PDDABS

MATN: MATTEN (MMAX, 7), MRCOEF (MMAX, 7), QA (MMAX), QR (MMAX), MFREQ (MMAX, 7), MERR, MTOT

Common to MASTER, ATTEN, LMATTER, RCOEF, RESONW

ROOMD: DDABS (RMAX + 6, RMAX + 6), DREFL, DREFLW

Common to MASTER, CFACTOR, SETUP, DFACTOR, LDDABS, IDDABS, RESOND, RESONW

ROOMN: ROOM (RMAX + 6, RMAX + 6), NROOMS, RAREA (RMAX)

Common to MASTER, CFACTOR, LRAREA, LROOM, PROOM, SETUP, ECALC, PPWR, PTMAT, IDDABS, DFACTOR, LDDABS, PPWR2, SPWR, RESOND, RESONW, PDDABS

TYPEC: TYPE (TMAX,3), TDB1 (TMAX)

Common to MASTER, CFACTOR, LTDB, LTYPE, PTDB, PTYPE, SRCHTDB, DFACTOR, RESOND

TYPEN: TDIM (TMAX, 4), TTOT, TDB2 (TMAX, 2), TDBTOT, TERR

Common to MASTER, CFACTOR, LTDB, LTYPE, PTDB, PTYPE, SRCHTDB, DFACTOR, RESOND

WALLC: WALL (WMAX, 4)

Common to MASTER, CFACTOR, LRAREA, LWALL, PWALL, DFACTOR, RESONW

WALLN: WDIM (WMAX, 3), WTOT, WERR

Common to MASTER, CFACTOR, LRAREA, LWALL, PWALL, DFACTOR, RESONW

4.5 Description of Programs and Subroutines Used in Field Calculation (Listed Alphabetically)

Important variables (not including those passed by common blocks) are listed after each routine. Subroutines with arguments are listed with the arguments in parentheses.

*<u>FUNCTION ATTEN (ID, FREQ, AFLAG)</u>: This real function returns the material attenuation for a specified frequency and for a specified quality. It obtains the attenuation values from the MATTEN array and interpolates according to the frequency.

ID: Material identification such as "MØ1".

*<u>SUBROUTINE CFACTOR</u>: This subroutine calculates the attenuation of each wall and each opening in each wall, layer by layer, and then calculates transmission factors for each wall.

DREFLW: This value is 20 dB near a window frequency resonance.

WATTEN: Wall attenuation.

OATTEN: Opening attenuation, whether the opening is a door or window.

LATTEN: Layer attenuation.

MATTEN: Material attenuation.

MATT: Material identifier such as "MØ1".

ID: Identifier of opening.

WALL: Wall array containing Wall identification and Material identification.

*FUNCTION DETERM (ARRAY, NORDER): This real function calculates the determinant of a matrix.

ARRAY (1-RMAX + 6, 1-RMAX + 6): This real array represents the input matrix. It is destroyed during the calculation.

NORDER This real variable represents the order of the input matrix.

*SUBROUTINE DFACTOR: This subroutine calculates the attenuation of each wall and each opening in each wall, layer by layer, and then calculates the absorption factor for each wall.

DREFL: Wall reflection coefficient.

WATTEN: Wall attenuation.

OATTEN: Opening attenuation, whether the opening is a door or a window.

LATTEN: Layer attenuation.

MATTEN: Material attenuation.

ID: Identifier of opening.

WALL: Wall array containing Wall identification and Material identification.

*SUBROUTINE ECALC: This subroutine calculates the energy balance in the rooms. It calls subroutines SETUP and DETERM.

PVECTOR (1-RMAX): This real array contains the values representing the initial power levels injected into each room from the outside field.

*SUBROUTINE ERROR (IERR): This subroutine returns an error message when called with an error number as argument. It also stops the program. The error numbers and error messages are listed below:

IERR	MESSAGE
1	Materials data base is empty
2	Frequency is out of range
3	This material is not in data base
4	Denominator is zero
5	File handling error

*FUNCTION GETLEN (STRING): This integer function returns the number of characters in a character string when given the character string as an argument.

*SUBROUTINE IDDABS: This subroutine initializes the DDABS array.

*SUBROUTINE LDDABS: This subroutine loads the DDABS array.

*SUBROUTINE LFREQ: This subroutine loads the array FREQA from the permanent file "BxxxxxP", where "xxxxx" represents the building identifier.

*SUBROUTINE LHOLE: This subroutine loads the material data base from permanent storage into the HOLE array for access by the program.

*SUBROUTINE LRAREA: This subroutine calculates the surface area of each room and inserts it into the RAREA array.

*SUBROUTINE LMATTER: This subroutine loads the material data base from permanent storage into arrays for access by the program.

*SUBROUTINE LROOM (TS, TS2, FROM, TO): This subroutine loads the transmission coefficients TS and TS2 into the appropriate room location in the ROOM array.

*SUBROUTINE LTDB: This subroutine calculates the attenuation and area of each type opening, layer by layer and loads it into the TDB array (Type Data Base).

*SUBROUTINE LTYPE: This subroutine loads arrays TYPE and TDIM with data from permanent file "BxxxxxT", where "xxxxx" is the building identifier.

*SUBROUTINE LWALL: This subroutine loads arrays WALL and WDIM with data from permanent file "BxxxxxW", where "xxxxx" is the building identifier.

*PROGRAM MASTER: This program is the control section which calls each of the subroutines. The program reads in wall, window and door data; calculates transmission coefficients of each wall; stores the transmission coefficients in the ROOM matrix; and calculates the maximum field in each room on a normalized basis. It is called by the user with procedure file FIELD.

*SUBROUTINE PDDABS: This subroutine prints the ROOM matrix.

*SUBROUTINE PTDB: This subroutine prints the array TDB1 and TDB2 giving the area and attenuation of each door and window type.

*SUBROUTINE PHOLE: This subroutine prints the contents of the HOLE array giving the wall location of the doors and windows.

*SUBROUTINE PPWR: This subroutine prints the contents of the ENERGY array and represents the energy values in the rooms.

*SUBROUTINE PPWR2: A second version of PPWR which allows a more efficient format. It uses the output from the subroutine SPWR stored in the array SWR.

*SUBROUTINE PROOM: This subroutine prints the ROOM array giving the transmission factor of each wall.

*SUBROUTINE PTMAT: This subroutine prints the contents of the TMAT array. It can be used for debugging the program.

*SUBROUTINE PTYPE: This subroutine prints the contents of the arrays TYPE and TDIM giving the parameters of each door and window type.

*SUBROUTINE PWALL: This subroutine prints the contents of the WALL and WDIM arrays.

*SUBROUTINE RESOND (ID): This subroutine calculates the range of frequencies that correspond to a resonance condition for a window or door with a metal frame. If the frequency of the incoming radiation is in the range of the resonance then DREFLW is set to 20 dB. This is used in the CFACTOR subroutine to increase the transmission through a window by 20 dB if resonance occurs.

DREFLW: This is the return variable. (Used in common block ROOMD.)

FLOW: This is the lower frequency bound for resonance.

FHIGH: This is the upper frequency bound for resonance.

ID: This is the identification label for the window.

*SUBROUTINE RESONW (FROM, MATID): This subroutine calculates the frequency range that corresponds to a resonance condition in a room. If a wall has a reflection coefficient greater than 0.80 and the frequency corresponds to resonance for the room, then DREFL is set to the reflection coefficient of the wall under question. Otherwise DREFL is set to zero.

DREFL: This is the return variable. (Used in common block ROOMD.)

FLOW: This is the lower frequency bound for resonance.

FHIGH: This is the upper frequency bound for resonance.

FROM: This identifies the room being calculated.

MATID: This represents the material identification label for the wall being calculated.

*FUNCTION RCOEF (MATID, FREQ, RFLAG): This function returns the material reflection coefficient for a specified frequency and for a specified quality.

*SUBROUTINE SETUP: This subroutine loads the TMAT array.

*SUBROUTINE SPWR: This subroutine saves the energy values as they are calculated so that they can be formatted neatly when printed.

*SUBROUTINE SRCHTDB (ID, OATTEN, OAREA): This subroutine searches the TDB array given the ID label of a door or window and returns the attenuation and area of that door or window.

*FUNCTION VAL (String): This function when given a number expressed as a character string returns the number expressed as an integer.

*<u>SUBROUTINE WARNING (IERR)</u>: This subroutine returns an error message when called with a warning number as argument. The warning number and message follows:

IERR	MESSAGE
1	HOLE data file does not exist for this bldg.
2	File handling problem on HOLE data file.
3	MATTER file does not exist for this bldg.
4	File handling problem on MATTER data file.
5	TYPE data file does not exist for this bldg.
6	File handling problem on TYPE file.
7	WALL data file does not exist for this bldg.
8	File handling problem on WALL file.
9	Height and width of room missing.
10	Length of room missing.
11	Frequency file does not exist for this building.
12	File handling problem with FREQ file.

5. USERS' GUIDE TO COMPUTER PROGRAMS FOR DATA ENTRY AND COMPUTATION

5.1 Introduction

The programs discussed in this chapter have been written for use on the Control Data Corporation Cyber 75Ø computer at the Boulder, Colorado Laboratories of the U.S. Department of Commerce. Though the programs contain checks and tests to help assure their correct use, we urge each user to read this guide carefully and to enter data (e.g., window and door types and locations) in the exact form and sequence which we specify. The checks and tests make the programs somewhat "user-friendly" but not entirely fool-proof (no offense intended).

When an electromagnetic wave is normally incident on an outside wall of a building, we compute the power attenuation of the wave as it penetrates the building by a procedure comprising the data files BxxxxxF, MATTER, BxxxxxW, BxxxxxT, and BxxxxxH, and the program MASTER.

- BxxxxxF: a file containing the frequencies to be used in the calculation. The suffix "F" stands for Frequency. The "xxxxx" in the name represents the identification name of a building, e.g., B9ØØ23F would be the frequency data file for building number 9ØØ23. This convention is used for all the other data files.
- MATTER: a file containing our computed reflection coefficients and attenuation values for building materials. Users will have direct interaction with this file only if they wish to change data or enter additional data for a material already in the file, or if they wish to enter data for an additional material.
- BxxxxxW: the user enters data on the location, size, and composition of walls in the building to be evaluated. The suffix "W" stands for Walls data.
- BxxxxxT: for each door and window type, the user enters material, size, and a two-character identification. The suffix "T" stands for Types data.
- BxxxxxH: in this file, the user specifies which doors and windows are located in each wall, identifying the door and window types by their two-character codes. The suffix "H" stands for Holes data.
- MASTER: this program computes the power attenuation when an electromagnetic field, incident on an exterior wall, penetrates into any room of a building. MASTER consults the files MATTER, BxxxxxW, BxxxxxT, and BxxxxxH to obtain the material and building data necessary for the computation. It uses the file BxxxxxF to determine which frequencies to use.

All programs are written in FORTRAN V for use on the CDC 75Ø computer.

5.2 Data Preparation for Programs SWALLS, STYPES, and SHOLES

The sequence ending in an attenuation computation begins with the user drawing a plan of the building to be analyzed. This plan helps the user derive the specifications for walls, doors, and windows which are then entered into the data files BxxxxxW, BxxxxxT, and BxxxxxH.

At this point we discuss typical steps in reducing the floor plan in figure 5.1 to a set of specifications acceptable to MASTER. The procedures we illustrate with this simple example can be used in the same manner for more complex structures. The only restriction on shape is that the floor plan be rectangular or composed of adjoining rectangles. The same restriction applies to room shapes. Examine the building thoroughly to include all features (walls, doors, windows) that determine its shielding characteristics.

The building plan must be labeled as follows (see the example in fig. 5.1):

1. D1, D2, D3, D4 denote the exterior regions, or "directions", around the building. These regions must be labeled in order to specify from which direction the radiation is coming. If necessary, D5 and D6 can be the regions above and below the building, or above and below a room (e.g., a second-floor room).
2. The directions LR (left-to-right) and FB (front-to-back) specify which walls are parallel to each other. This information is useful if two parallel walls (of the same room) have high reflection coefficients, because the region between them may contain the intensified fields of standing waves produced by reflections between the walls. The program MASTER computes the highest and lowest frequencies at which these resonances may occur.
3. Label the rooms Ø1, Ø2, Ø3 . . . .
4. Determine the window and door types in the building; label these WA, WB, ..., and DA, DB, ..., respectively, at their locations on the floor plan.

To prepare data for entry into the file BxxxxxW, the user should make a data sheet to specify the size, orientation, and composition of the walls. A suggested format is shown in figure 5.2:

1. The number of each line of data is given in the "LINE#" column. When changing or entering a line of data, the user employs the line number. Note that the line numbers are shown in Figure 5.1, also.
2. The column "DIRECTION" specifies the direction to which the wall in a given line is perpendicular. This direction must be the same as that defined by the "FROM" and "TO" columns.
3. Note that lines 1, 2, 3 specify the material layers in the wall between region D4 and room Ø1, and that these layers are encountered in that sequence in going from D4 to Ø1. The material layers in a wall must be entered in the file in the correct sequence corresponding to the direction given by the "FROM" and "TO" columns.

4. The wall "HEIGHT" (meters), "LENGTH" (meters), and "THICKNESS" of material layer (centimeters) are entered in their respective columns.
5. The material identification number of each layer is entered in the "MATERIAL" column according to the material data tables in chapter 2.

We strongly advise that the user employ some means of marking the building plan as each wall is entered into the BxxxxxW data table. When the table is complete and all walls are so marked (e.g., a pencil check; a colored highlight), the user will know that none have been omitted (or perhaps entered twice). It can also be helpful to put the data table line numbers onto the drawing as they are entered into the table. In figure 5.1, these line numbers are shown at the intersections of the walls with the cross-sections (dashed lines) through the building.

To tabulate the types of doors (D) and windows (W) indicated in figure 5.1, we suggest the format in figure 5.3. From left to right, the columns specify doors and windows as follows:

1. Line numbers (the "LINE" column) are used in adding, deleting, and displaying data.
2. The floor plan in figure 5.1 has door types DA, DB, DC, and window types WA, WB.
3. A door or window has a height of H meters and a width of W meters, where H and W are the inside dimensions of a door frame and a window sash (the frame in which the glass is set).
4. "DISTANCE ABOVE FLOOR" is the distance in meters from the floor to the bottom edge of the glass or screen in a window.
5. In the next two columns, the "LAYER MATERIAL" (door or window) and its "THICKNESS" (in cm) are specified for each door and window. Notice that doors and windows may contain more than one material: window type WA has galvanized mesh screen (material MØ9) and window glass (MØ8). The user may also encounter storm windows, windows with thermopane (double-layer) glass, storm doors, and screen doors.
6. "FRAME MATERIAL"; obtain identification (e.g., MØ4) for the frame material from the material data tables.

In the specification of walls and the openings in them, all that remains now is to prepare data for BxxxxxH, the holes file which tells MASTER where the doors and windows are located. A suitable format for tabulating this data is given in figure 5.4. As before, a wall is identified by specifying 1) the two regions between which the wall is located and 2) the direction to which the wall is perpendicular (this orients the wall with respect to left-right or front-back directions). Because the wall "from D4 to Ø1" has two types of openings, it is listed twice (lines 3 and 4).

We again urge users to prepare their data for entry into the computer files by using the tabular formats we have suggested (figures 5.2, 5.3, 5.4). This procedure will reduce careless errors in transcribing building specifications from the floor plan to files BxxxxxW, BxxxxxT, and BxxxxxH.

5.3 How to Become a Remote-Site Time-Share User

Having prepared a floor plan and building data tables, the user must now enter this data into the files BxxxxxF, BxxxxxW, BxxxxxT, and BxxxxxH. Before we present details of how this is done, we describe how one becomes an off-site time-share user of the Control Data Corporation (CDC) 17Ø/75Ø computer system at the Boulder Laboratories of the U.S. Department of Commerce.

To establish a relationship with the computer, call User Services: (3Ø3) 497-5849 or (3Ø3) 497-585Ø (on FTS, 3Ø3 is a direct dial area code). When first contacting the Computer Services Division through User Services, prospective users must furnish 1) their name, organization name, and telephone number, and 2) the name and telephone number of an "authority contact" (i.e., a project leader, supervisor, etc.). User Services will then provide a user number and an initial password. When a billing account is established and the way is cleared for use of the computer, the user changes the initial password to another one which is then secure, known only to the user.

A password (4-7 alphanumeric characters) must be changed every three months, otherwise the computer will assign a new one known only to the computer. The user will then be unable to get on line without first going through User Services to submit a new password. At each log-in for about ten days prior to the expiration of a password, the computer reminds the user to enter a new one. A password is changed by the command

PASSWOR, OLDPSWD, NEWPSWD

in which the user supplies the old password (OLDPSWD) and then the new password (NEWPSWD).

To obtain an account number for computer charges, the user's purchasing department should send a purchase order to

Ms. Beverly Armstrong
NOAA/ERL, R-E52
U.S. Department of Commerce
325 Broadway
Boulder, Colorado 8Ø3Ø3.

Ms. Armstrong can be reached on (3Ø3) 497-5842 (FTS direct dial).

Dan Smith (3Ø3-497-5846) or Ron Buxton (3Ø3-497-5845) can advise which direct-dial extension to use to match the baud rate on the user's terminal.

5.4 The CDC 17Ø/75Ø: Data Entry and Computation

5.4.1 Log-In Procedure

Once the user is on-line, the initial conversation with the computer will be as shown in figure 5.5. In reply to the first three requests, the user enters: family name, user number, and password. If no family name is required, press the CR key (CR = carriage return). When typed, the user number does not appear on the printout. The password is typed over the blackened area. After the word "CHARGE:", the user enters

CHARGE, Z1234567,Z

(or a similar form specified by User Services) where "1234567" represents the user's account number. As seen in this printout, entering the word BYE disconnects the user from the computer.

5.4.2 Procedure File MSTORE

The file MATTER contains all the attenuation and reflection data in the tables in chapter 2. To add or change data, one uses the procedure file MSTORE (M for material), and obtains it with the BEGIN command

BEGIN, MSTORE

Figure 5.6 illustrates how the user enters building material data by means of MSTORE, which first asks if the user wants to (1) create a new data base, or (2) add to the existing data base. The user makes the choice by typing 1 or 2 after the question mark. (Note that whenever MSTORE awaits a user reply, it types a question mark as a prompt to the user.) If a data base is already present in the MATTER file and the user chooses to create a new data base, typing 1 ERASES THE EXISTING BASE. Before making this choice, the user must be certain this is indeed what is wanted. Also, one must take care not to inadvertently type the numeral 1 when 2 is intended.

The entry of material description and data is complete when the user has responded to the six prompts. (NOTE: a character string must be typed within single quotes; e.g., 'MOIST CLAY BRICK', 'M15'.) MSTORE then presents the choice of (1) adding data for another material, (2) changing data in the base, (3) displaying the data for material in the base, (4) canceling (aborting) the data set just entered, or (5) quitting the data-entry procedure. The choice (5) enters the new data into the file MATTER.

Figure 5.7 shows the user how to use MSTORE to change data already in MATTER. After the material identification MØ5 is entered, MSTORE prints all specifications for MØ5, and the user then enters the line number of the data to be changed. The procedure to change the attenuation quality percent from 1ØØ to 1Ø is then self-evident. After all changes have been made and the user has entered 99 to leave the "change" mode, the complete revised data for MØ5 is presented. Entering 5 (the "quit" option)

disconnects the user from MSTORE and enters the revised data into the file MATTER. To reestablish contact with the procedure file MSTORE, the user must again enter BEGIN, MSTORE.

The entire data entry for a material can be deleted simply by using the "change" option to replace the material identification in line 1 (e.g., MØ5) with a blank. Enter two consecutive single quotes as the changed material ID; the absence of information between them is the blank.

5.4.3 Data File BxxxxxW (W for Walls)

In the file BxxxxxW, the user stores the location, dimensions, and composition of each wall in each building to be analyzed. Every building thus specified in BxxxxxW must be identified by a string of no more than five alphanumeric characters represented by xxxxx here. Building identification is the first information requested as the user begins entering or changing data in the BxxxxxW file.

Manipulating data in BxxxxxW is done through the procedure file WSTORE; that is, WSTORE is the procedure file by which the user creates and/or alters the data file BxxxxxW. Contact with BxxxxxW is therefore initiated by the command

BEGIN, WSTORE

Figure 5.8(a) illustrates the format for entering data, via WSTORE, into the file BxxxxxW. First, the user enters an identification number assigned to the building whose walls are to be documented. This identification number replaces the "xxxxx" in the file name forming a unique name. Then comes the payoff for care taken in tabulating wall data (fig. 5.2), for WSTORE now requests this data in the left-to-right order of the tabulation. Note that when data has been entered for a wall layer, entering another layer for that wall requires only "thickness of layer" and "material ID" (directional data, height, and width are the same for all layers in a given wall). If the user discontinues data entry, WSTORE presents the seven options at the top of figure 5.8(b).

Option 1: a line can be displayed as shown in figure 5.8(b). Entering the number "Ø" instead of a line number allows the user to leave the display mode.

Option 2: options 2 and 5 are similar in that they both involve adding data lines to an existing file. While 5 is only for adding a data line at the end of the file, option 2 allows the user to insert a data line between two other lines (fig. 5.8(c)). When this is done, the inserted line must be part of a wall already represented in the file (otherwise, option 5 would be used). For this reason, the user must be sure that the directions, height, and width of the inserted line match those of one (or perhaps both) of the adjacent lines (depending on whether one or both of the adjacent lines belong to the door/window of the inserted line). If the user enters the data incorrectly and the line does not match at least one of its neighbors, WSTORE will emphatically point out the error. This error message is shown at the bottom of figure 5.8(c). Note that the faulty line has

not been accepted (i.e., not entered into the BxxxxxW files); the user must again choose option 2 and enter the corrected data.

Option 3: this option allows the user to delete a line of data (fig. 5.8(d)). The procedure is self-explanatory. Revised data can be entered using option 2 or 5, whichever is appropriate.

Option 4: displays all data for this building so far entered into BxxxxxW.

Option 5: adds a line of data at the end of an existing file. If the added line is another layer in the last wall in the file, the user is asked only for layer thickness and material ID. If the added line is the first layer of a new wall in the file, the format for entering the data is the same as in option 2 (fig. 5.8(c)). Neither choice within option 5 requires matching the entered data with that in an adjacent line.

Options 6 and 7: option 6 (fig. 5.8(d)) stores new data in file BxxxxxW, or replaces existing data in BxxxxxW with a revised version of that data. If the user does not wish to store the new or revised data just entered, option 7 can be used to cancel that data and leave the BxxxxxW file unchanged.

5.4.4 Data File BxxxxxT (T for Types)

In this file the user stores data from the table of door and window types and specifications (fig. 5.3). The procedure for entering this data is TSTORE, and the procedures for data entry, the cautionary comments, and the error messages are almost identical to those employed in the procedure WSTORE. Therefore, familiarity with WSTORE is sufficient warmup for using the procedure TSTORE to enter data into the file BxxxxxT. Figure 5.9 illustrates the format for data entry using TSTORE; the similarity with WSTORE is obvious.

Because doors and windows may have layers (e.g., storm doors, storm windows, screens), an insert-line-into-file option is again one of seven data-handling choices available. As in WSTORE, an inserted line of data represents an additional layer of a door or window already in the file. Therefore, the identifier (e.g., DE, WC), frame material, height, width, and distance above floor in the inserted line must match those specifications in one or both of the adjacent lines. If not, the error message and the procedure for changing the incorrect line of data are the same as in WSTORE.

The user gains access to TSTORE with the command

BEGIN, TSTORE.

Building identification is required before data entry begins.

5.4.5 Data File BxxxxxH (H for Holes)

The user stores in the file BxxxxxH the types and locations of all doors and windows in the building to be analyzed; location is given by specifying the wall containing each door and window. This data

should have been previously tabulated as in figure 5.4, and is now to be entered into the data file BxxxxxH by means of the procedure HSTORE. Again, the summons is

BEGIN, HSTORE

and building identification is required to initiate data entry (fig. 5.1∅).

Though not necessary, it may be a bookkeeping convenience to enter together the data for all doors and windows in a given wall. If option 2 ("insert line into file") is employed for this purpose, the user will be pleased to know that HSTORE does not require matching between inserted and adjacent lines. Therefore, HSTORE, while very similar to MSTORE, WSTORE, and TSTORE, is also simpler and will present no difficulties to a user familiar with the other three data entry programs.

5.4.6 Data File BxxxxxF (F for Frequency)

The user stores in the file BxxxxxF the frequencies required for the calculation using the procedure file FSTORE. The program is begun by the command,

BEGIN, FSTORE.

If no BxxxxxF file is created, the program MASTER will use a set of default frequencies in the calculation.

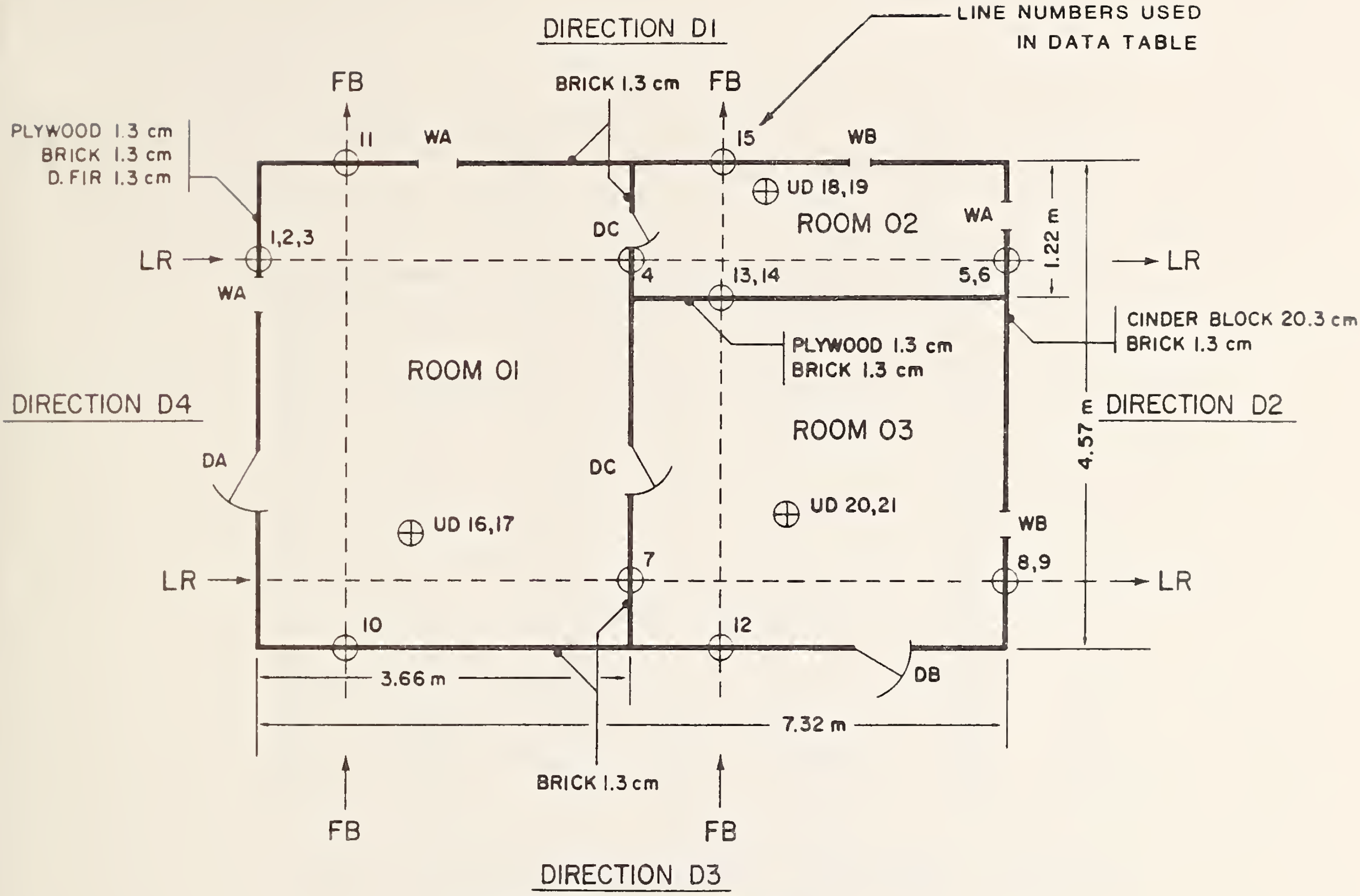
5.4.7 Computation Program MASTER

The program MASTER obtains building data from the files MATTER, BxxxxxW, BxxxxxT, and BxxxxxH, and computes the attenuation (in dB) for each room; that is, the attenuation of externally incident radiation as it penetrates into each room of the building. The user must be sure these files contain all the necessary data before consulting MASTER. When the files are ready, the user activates MASTER by entering

BEGIN, FIELD.

The procedure file FIELD summons MASTER, the data files, and the subroutines required by MASTER for its data handling operations. The only information that FIELD asks of the user is the identification code of the building to be analyzed. When the user enters this building identification, the computation begins.

For each of the five directions from which radiation may be incident on the building (e.g., north, east, south, west, above), MASTER computes all room attenuations for the frequencies given in the data file BxxxxxF. If the frequency file is missing, MASTER will use the seven default frequencies given in the material data tables. The printed output begins with a listing of the data files BxxxxxW, BxxxxxH, and BxxxxxT (fig. 5.11a); then the attenuation values are given (fig. 5.11b) by frequency, direction, and room. The data in figure 5.11 a,b are for the sample building whose wall, door, and window specifications were obtained from figure 5.1. Actual results based on field measurements are shown in chapter 7.



FLOOR PLAN OF SAMPLE BUILDING

NOTES:

WINDOW DATA

WA 1.2 m (H) x 0.91 m (W), plywood frame, 1 cm glass with 0.61 cm thick 24x24 galvanized steel mesh

WB 1.2 m (H) x 1.5 m (W), aluminum frame, 1 cm glass with 0.61 cm thick 24x24 galvanized steel mesh

DOORS

DA 2.10 m (H) x 0.91 m (W) plywood door, 5.1 cm thick with wood frame

DB 2.10 m (H) x 1.20 m (W) plywood door 5.1 cm thick with wood frame

DC 2.10 m (H) x 2.10 m (W) plywood door 1.3 cm thick with aluminum frame

WALLS

All heights are 2.44 m.

FLOOR

Cement 1.30 cm thick.

CEILING

Wood (Fir) 1.30 cm

Figure 5.1 Layout of sample building used for illustrating data input.

LINE #	DIRECTION	FROM	TO	HEIGHT	WIDTH	THICKNESS	MATERIAL
1	LR	D4	01	2.44	4.57	1.30	M05
2	LR	D4	01	2.44	4.57	1.30	M06
3	LR	D4	01	2.44	4.57	1.30	M04
4	LR	01	02	2.44	1.22	1.30	M06
5	LR	02	D2	2.44	1.22	20.30	M07
6	LR	02	D2	2.44	1.22	1.30	M06
7	LR	01	03	2.44	3.35	1.30	M06
8	LR	03	D2	2.44	3.35	20.30	M07
9	LR	03	D2	2.44	3.35	1.30	M06
10	FB	D3	01	2.00	3.66	1.30	M06
11	FB	01	D1	2.44	3.66	1.30	M06
12	FB	D3	03	2.44	3.66	1.30	M06
13	FB	03	02	2.44	3.66	1.30	M05
14	FB	03	02	2.44	3.66	1.30	M06
15	FB	02	D1	2.44	3.66	1.30	M06
16	UD	D5	01	4.57	3.66	1.30	M04
17	UD	01	D6	4.57	3.66	1.30	M02
18	UD	D5	02	1.22	3.66	1.30	M04
19	UD	02	D6	1.22	3.66	1.30	M02
20	UD	D5	03	3.35	3.66	1.30	M04
21	UD	03	D6	3.35	3.66	1.30	M02

Figure 5.2. Example of wall data tabulation for walls in figure 5.1.

LINE	ID	HEIGHT (METERS)	WIDTH (METERS)	DISTANCE ABOVE FLOOR	THICKNESS (CM)	LAYER MATERIAL	FRAME MATERIAL
1	DA	2.10	.91	0.00	5.10	M05	M05
2	DB	2.10	1.20	0.00	5.10	M05	M05
3	DC	2.10	2.10	0.00	1.30	M05	M13
4	WA	1.20	.91	.61	1.00	M08	M05
5	WA	1.20	.91	.61	.61	M09	M05
6	WB	1.20	1.50	.91	1.00	M08	M13
7	WB	1.20	1.50	.91	.61	M09	M13

Figure 5.3. Format for preparing door and window specifications for entry into file BxxxxxT.

LINE #	DIRECTION	FROM	TO	ID
1	LR	03	D2	WB
2	FB	D3	03	DB
3	LR	D4	01	WA
4	LR	D4	01	DA
5	LR	01	02	DC
6	LR	01	03	DC
7	FB	01	D1	WA
8	FB	02	D1	WB
9	LR	02	D2	WA

Figure 5.4. Format for preparing door and window location data for entry into file BxxxxxH (sample data from figure 5.1).

```
 83/09/14. 14.14.30.
N O A A / M A S C  170/750  83/06/26.   NOS 1.4 531/552.40
FAMILY:
        USER NUMBER:
                     PASSWORD
XXXXXXXX
TERMINAL:    220, TTY
RECOVER/ CHARGE: CHARGE,Z7233491,Z
/BYE

WYSS      LOG OFF    14.14.49.
WYSS      SRU      1.002 UNTS.
```

Figure 5.5. The log-in procedure.

```
/BEGIN,MSTORE.
 (1) CREATE NEW DATABASE  (2) ADD TO EXISTING DATA BASE
? 2
 (1) NEXT DATA ENTRY  (2) CHANGE  (3) DISPLAY  (4) ABORT  (5) QUIT
? 1

 MATERIAL I.D.?  (E.G.  M05 OR M12)
? 'M15'
 INDEX:15
 ENTER ONE LINE DESCRIPTION OF MATERIAL
? 'MOIST CLAY BRICK'
 ENTER 7 ATTENUATION VALUES FROM LOW TO HIGH FREQ
? .0000022,.0000102,.00014,.0025,.00572,.00572,.0057
 ENTER ATTENUATION QUALITY PERCENT
? 10.
 ENTER 7 REFLECTION COEFFS FROM LOW TO HIGH FREQ
? .13,.072,.051,.029,.014,.014,.014
 ENTER REFLECTION COEFICIENT QUALITY PERCENT
? 100.

 (1) NEXT DATA ENTRY  (2) CHANGE  (3) DISPLAY  (4) ABORT  (5) QUIT
? 5

REVERT.  MSTORE COMPLETED.
/
```

Figure 5.6. Entering building material data into the file MATTER.

```
/BEGIN,MSTORE.
 (1) CREATE NEW DATABASE  (2) ADD TO EXISTING DATA BASE
? 2
 (1) NEXT DATA ENTRY  (2) CHANGE  (3) DISPLAY  (4) ABORT  (5) QUIT
? 2

 ENTER MATERIAL I D. OF GROUP TO BE CHANGED
? 'M05'

 LINE 1      MATERIAL ID
 M04
 LINE 2       DESCRIPTION
 FIR PLYWOOD
 LINE 3:       FREQUENCIES
 10000. 100000. 1000000. 10000000. 100000000. 1000000000.
 1 E+10
 LINE 4:       ATTENUATIONS
 .00000115 .00000677 .00000831 .000124 .00215 .026 .3
 LINE 5:       ATTENUATION QUALITY PERCENT
 100.
 LINE 6:      REFLECTION COEFFICIENTS
 .068 .048 .074 .036 .014 .013 .01
 LINE 7:  REFLECTION QUALITY PERCENT
 100.

 ENTER NUMBER OF LINE TO BE CHANGED      (99 TO END CHANGES)
? 5
 ENTER NEW ATTENUATION QUALITY PERCENT
? 10.

 ENTER NUMBER OF LINE TO BE CHANGED      (99 TO END CHANGES)
? 99

 M05
 FIR PLYWOOD
 10000. 100000. 1000000. 10000000. 100000000. 1000000000.
 1.E+10
 .00000115 .00000677 .00000831 .000124 .00215 .026 .3
 10.
 .068 .048 .074 .036 .014 .013 .01
 100.

 (1) NEXT DATA ENTRY  (2) CHANGE  (3) DISPLAY  (4) ABORT  (5) QUIT
? 5

REVERT.  MSTORE COMPLETED.
/
```

Figure 5.7. Changing building material data in the file MATTER by means of the procedure file MSTORE.

```
/BEGIN,WSTORE.

 ENTER BUILDING IDENTIFICATION  (E.G. '101')
     (NO MORE THAN 5 ALPHANUMERIC CHARACTERS)
? '701'

 WILL THIS BE
    (1) A MODIFICATION OF AN EXISTING FILE?
    (2) A NEW FILE?
 ENTER A NUMBER  !!!
? 2

  BEGIN ENTERING DATA

 ENTER DIRECTION (E. G. 'LR')
? 'LR'

 ENTER "FROM" (E.G. '02' OR 'D1')
? 'D4'

 ENTER "TO"  (E.G. '02' OR 'D1')
? '01'

 ENTER HEIGHT, METERS
? 2.44

 ENTER WIDTH, METERS
? 4.57

 ENTER THICKNESS OF LAYER, CENTIMETERS
? 1.30

 ENTER "MATERIAL ID" (E.G. 'M01')
? 'M05'

 DO YOU WANT TO ENTER MORE DATA?(1) YES  (2) NO
   ENTER A NUMBER !!!
? 1

 IS THIS THE FIRST LAYER OF A WALL   (1) YES (2) NO
      ENTER "0" TO ESCAPE "DATA ENTRY" MODE
  ENTER A NUMBER!!
? 2

 ENTER THICKNESS OF LAYER, CENTIMETERS
? 1.30

 ENTER "MATERIAL ID" (E.G. 'M01')
? 'M06'

 DO YOU WANT TO ENTER MORE DATA?(1) YES  (2) NO
   ENTER A NUMBER !!!
? 2

 DATA ENTRY DISCONTINUED
```

Figure 5.8(a). Procedure file WSTORE is used to enter wall data into file BxxxxxW. Data is entered in the sequence of columns in figure 5.2.

```
CHOOSE
   (1) DISPLAY LINE OF DATA  (4) DISPLAY ALL LINES
   (2) INSERT LINE INTO FILE (5) APPEND LINES OF DATA
   (3) DELETE LINE           (6) STORE DATA AND EXIT PROGRAM
                             (7) EXIT PROGRAM WITHOUT STORING DATA
ENTER A NUMBER !!!

? 1

SPECIFY THE NUMBER OF THE LINE TO BE DISPLAYED
     ( ENTER "0" TO ESCAPE DISPLAY MODE )
? 1

  LINE #   DIRECTION   FROM   TO   HEIGHT   WIDTH   THICKNESS   MATERIAL
    1         LR        D4    01    2.44     4.57      1.30        MO5

CHOOSE
   (1) DISPLAY LINE OF DATA  (4) DISPLAY ALL LINES
   (2) INSERT LINE INTO FILE (5) APPEND LINES OF DATA
   (3) DELETE LINE           (6) STORE DATA AND EXIT PROGRAM
                             (7) EXIT PROGRAM WITHOUT STORING DATA
ENTER A NUMBER !!!

? 6

DOUBLE CHECK !!!
    DO YOU YOU WANT TO STORE THIS DATA AND END PROG
  NOTE: STORING THIS DATA WILL WIPE OUT ANY OLD FILE
  OF THE SAME NAME !!!
        ENTER A NUMBER: (1) YES   (2) NO
? 1

DATA HAS BEEN STORED AND PROGRAM TERMINATED
REVERT.  WSTORE COMPLETED.
/
```

Figure 5.8(b). (Continued from figure 5.8(a)) How the display mode allows the user to examine a line of data.

```
/BEGIN,WSTORE.

 ENTER BUILDING IDENTIFICATION  (E.G. '101')
     (NO MORE THAN 5 ALPHANUMERIC CHARACTERS)
? '701'

 WILL THIS BE
    (1) A MODIFICATON OF AN EXISTING FILE?
    (2) A NEW FILE?
 ENTER A NUMBER  !!!
? 1

 CHOOSE
    (1) DISPLAY LINE OF DATA  (4) DISPLAY ALL LINES
    (2) INSERT LINE INTO FILE (5) APPEND LINES OF DATA
    (3) DELETE LINE           (6) STORE DATA AND EXIT PROGRAM
                              (7) EXIT PROGRAM WITHOUT STORING DATA
 ENTER A NUMBER !!!

? 2

 SPECIFY NUMBER OF LINE BEFORE WHICH A NEW LINE IS TO BE INSERTED
      ( ENTER "0" TO ESCAPE "INSERTION" MODE )
? 2

 ENTER DIRECTION (E. G. 'LR')
? 'LR'

 ENTER "FROM" (E.G. '02' OR 'D1')
? '06'

 ENTER "TO"  (E.G. '02' OR 'D1')
? '05'

 ENTER HEIGHT, METERS
? 2.44

 ENTER WIDTH, METERS
? 2.0

 ENTER THICKNESS OF LAYER, CENTIMETERS
? 2.0

 ENTER "MATERIAL ID" (E.G. 'M01')
? 'M01'

 YOUR DATA WAS NOT ACCEPTED !!!
   YOUR DATA MUST REPRESENT A LAYER IN AN EXISTING WALL
   I.E.  THE DIRECTION, FROM, TO, HEIGHT, AND WIDTH
         PARAMETERS MUST MATCH THE WALL JUST BEFORE
         OR JUST AFTER YOUR SPECIFIED INSERTION POINT

 THE FOLLOWING DISPLAYS
 THE LINE BEFORE YOUR LINE,
 YOUR LINE, AND THE LINE AFTER

   LINE #   DIRECTION   FROM   TO   HEIGHT   WIDTH   THICKNESS   MATERIAL
      1        LR        D4    01     2.44    4.57      1.30        M05
   LINE #   DIRECTION   FROM   TO   HEIGHT   WIDTH   THICKNESS   MATERIAL
      2        LR        06    05     2.44    2.00      2.00        M01
   LINE #   DIRECTION   FROM   TO   HEIGHT   WIDTH   THICKNESS   MATERIAL
      3        LR        D4    01     2.44    4.57      1.30        M06
```

Figure 5.8(c). The WSTORE sequence for inserting data into the file BxxxxxW. Note error message when an incorrect line is inserted.

```
 CHOOSE
    (1) DISPLAY LINE OF DATA  (4) DISPLAY ALL LINES
    (2) INSERT LINE INTO FILE (5) APPEND LINES OF DATA
    (3) DELETE LINE           (6) STORE DATA AND EXIT PROGRAM
                              (7) EXIT PROGRAM WITHOUT STORING DATA
 ENTER A NUMBER !!!

? 3

 SPECIFY THE NUMBER OF THE LINE TO BE DELETED
    (ENTER "0" TO ESCAPE DELETION MODE)
? 1

 DOUBLE CHECK !!!
      DO YOU WANT TO DELETE THE FOLLOWING LINE?:
   LINE #   DIRECTION   FROM   TO   HEIGHT   WIDTH   THICKNESS   MATERIAL
      1        LR        D4    01     2.44    4.57       1.30        M05
    ENTER (1) YES  OR   (2) NO
? 1

 LINE # 1 DELETED

 CHOOSE
    (1) DISPLAY LINE OF DATA  (4) DISPLAY ALL LINES
    (2) INSERT LINE INTO FILE (5) APPEND LINES OF DATA
    (3) DELETE LINE           (6) STORE DATA AND EXIT PROGRAM
                              (7) EXIT PROGRAM WITHOUT STORING DATA
 ENTER A NUMBER !!!

? 6

 DOUBLE CHECK !!!
     DO YOU YOU WANT TO STORE THIS DATA AND END PROG
   NOTE: STORING THIS DATA WILL WIPE OUT ANY OLD FILE
   OF THE SAME NAME !!!
         ENTER A NUMBER: (1) YES   (2) NO
? 1

 DATA HAS BEEN STORED AND PROGRAM TERMINATED
REVERT.  WSTORE COMPLETED.
/
```

Figure 5.8(d). WSTORE: how to delete data (option 3), and use of option 6 to store entered data and terminate WSTORE.

```
/BEGIN,TSTORE

 ENTER BUILDING IDENTIFICATION  (E.G. '101')
    (NO MORE THAN 5 ALPHANUMERIC CHARACTERS)
? 701
     701 <-ERROR IN COL.  4, RETYPE RECORD FROM THIS FIELD
? '701'

 WILL THIS BE
   (1) A MODIFICATION OF AN EXISTING FILE?
   (2) A NEW FILE?
 ENTER A NUMBER  !!!
? 2

  BEGIN ENTERING DATA

 ENTER 'ID' (E.G. 'WA' OR 'DE')
? 'WA'

 ENTER HEIGHT, METERS
? 2

 ENTER WIDTH, METERS
? .98

 ENTER DISTANCE ABOVE FLOOR, METERS
? 1

 ENTER THICKNESS OF LAYER, CENTIMETERS
? .4

 ENTER "MATERIAL ID OF LAYER" (E.G. 'M01')
? 'M05'

 ENTER "MATERIAL ID OF FRAME" (E.G. 'M01')
? 'M08'

 DO YOU WANT TO ENTER MORE DATA?(1) YES  (2) NO
   ENTER A NUMBEER !!!
? 1

 IS THIS THE FIRST LAYER OF A DOOR OR WINDOW?  (1) YES (2) NO
     ENTER "0" TO ESCAPE "DATA ENTRY" MODE
  ENTER A NUMBER!!
? 2

 ENTER THICKNESS OF LAYER, CENTIMETERS
? 1

 ENTER "MATERIAL ID OF LAYER" (E.G. 'M01')
? 'M04'

 DO YOU WANT TO ENTER MORE DATA?(1) YES  (2) NO
   ENTER A NUMBEER !!!
? 2

 DATA ENTRY DISCONTINUED

 CHOOSE
   (1) DISPLAY LINE OF DATA  (4) DISPLAY ALL LINES
   (2) INSERT LINE INTO FILE (5) APPEND LINES OF DATA
   (3) DELETE LINE           (6) STORE DATA AND EXIT PROGRAM
                             (7) EXIT PROGRAM WITHOUT STORING DATA
 ENTER A NUMBER !!!
```

Figure 5.9. The procedure TSTORE enters data on door and window types into file BxxxxxT.

```
/BEGIN,HSTORE

 ENTER BUILDING IDENTIFICATION  (E.G. '101')
      (NO MORE THAN 5 ALPHANUMERIC CHARACTERS)
? '701'

 WILL THIS BE
    (1) A MODIFICATION OF AN EXISTING FILE?
    (2) A NEW FILE?
 ENTER A NUMBER  !!!
? 2

  BEGIN ENTERING DATA

 ENTER DIRECTION (E. G. 'LR')
? 'LR'

 ENTER "FROM" (E.G. '02' OR 'D1')
? 'D2'

 ENTER "TO"  (E.G. '02' OR 'D1')
? '03'

 ENTER HOLE 'ID' (E.G. 'WA' OR 'DA')
? 'WB'

 DO YOU WANT TO ENTER MORE DATA?(1) YES  (2) NO
   ENTER A NUMBER !!!
? 1

 ENTER DIRECTION (E. G. 'LR')
? 'TB'
 DIRECTION MUST BE 'LR' OR 'FB' OR 'UD'
 TRY AGAIN!!!

 ENTER DIRECTION (E. G. 'LR')
? 'FB'

 ENTER "FROM" (E.G. '02' OR 'D1')
? 'D3'

 ENTER "TO"  (E.G. '02' OR 'D1')
? '03'

 ENTER HOLE 'ID' (E.G. 'WA' OR 'DA')
? 'DB'

 DO YOU WANT TO ENTER MORE DATA?(1) YES  (2) NO
   ENTER A NUMBER !!!
? 2

 DATA ENTRY DISCONTINUED

 CHOOSE
    (1) DISPLAY LINE OF DATA  (4) DISPLAY ALL LINES
    (2) INSERT LINE INTO FILE (5) APPEND LINES OF DATA
    (3) DELETE LINE           (6) STORE DATA AND EXIT PROGRAM
                              (7) EXIT PROGRAM WITHOUT STORING DATA
 ENTER A NUMBER !!!

? 4

   LINE #   DIRECTION   FROM   TO   ID
      1        LR        D2    03   WB
      2        FB        D3    03   DB
```

Figure 5.10. Procedure HSTORE enters into file BxxxxxH the types and locations of doors and windows.

```
/BEGIN,FIELD
ENTER BUILDING IDENTIFICATION  (E.G. '101')
    (NO MORE THAN 5 ALPHANUMERIC CHARACTERS)
? '701'
BUILDING IDENTIFICATION ENTERED AS '701'
ENTER NUMBER OF ROOMS IN BUILDING
? 3
```

WALL IDENTIFICATION			WALL PARAMETERS			
DIR	FROM	TO	MATERIAL	HEIGHT	WIDTH	THICKNESS
LR	D4	01	M05	2.44	4.57	1.30
LR	D4	01	M06	2.44	4.57	1.30
LR	D4	01	M04	2.44	4.57	1.30
LR	01	02	M06	2.44	1.22	1.30
LR	02	D2	M07	2.44	1.22	20.30
LR	02	D2	M06	2.44	1.22	1.30
LR	01	03	M06	2.44	3.35	1.30
LR	03	D2	M07	2.44	3.35	20.30
LR	03	D2	M06	2.44	3.35	1.30
FB	D3	01	M06	2.00	3.66	1.30
FB	01	D1	M06	2.44	3.66	1.30
FB	D3	03	M06	2.44	3.66	1.30
FB	03	02	M05	2.44	3.66	1.30
FB	03	02	M06	2.44	3.66	1.30
FB	02	D1	M06	2.44	3.66	1.30
UD	D5	01	M04	4.57	3.66	1.30
UD	01	D6	M02	4.57	3.66	1.30
UD	D5	02	M04	1.22	3.66	1.30
UD	02	D6	M02	1.22	3.66	1.30
UD	D5	03	M04	3.35	3.66	1.30
UD	03	D6	M02	3.35	3.66	1.30

DOOR AND WINDOW LOCATIONS

	WALL IDENTIFICATION		
ID	DIRECTION	FROM	TO
WB	LR	03	D2
DB	FB	D3	03
WA	LR	D4	01
DA	LR	D4	01
DC	LR	01	02
DC	LR	01	03
WA	FB	01	D1
WB	FB	02	D1
WA	LR	02	D2

DOOR AND WINDOW PARAMETERS

ID	MATERIAL	FRAME MATERIAL	HEIGHT	WIDTH	LAYER THICKNESS	DISTANCE ABOVE FLR
DA	M05	M05	2.10	.91	5.10	0.00
DB	M05	M05	2.10	1.20	5.10	0.00
DC	M05	M13	2.10	2.10	1.30	0.00
WA	M08	M05	1.20	.91	1.00	.61
WA	M09	M05	1.20	.91	.61	.61
WB	M08	M13	1.20	1.50	1.00	.91
WB	M09	M13	1.20	1.50	.61	.91

Figure 5.11(a). An output of the program MASTER giving room attenuation (in dB) vs. frequency and direction of the incident radiation for building shown in figure 5.1.

ATTENUATION AT A FREQUENCY OF 1.000E+06 HZ

ROOMS	DIRECTIONS 1	2	3	4	5
1	-.96	-11.21	-1.34	-.41	2.23
2	1.13	-2.92	-5.32	-12.28	.89
3	-3.86	-.51	.65	-11.80	2.70

ATTENUATION AT A FREQUENCY OF 1.000E+07 HZ

ROOMS	DIRECTIONS 1	2	3	4	5
1	-.97	-11.22	-1.35	-.41	2.23
2	1.13	-2.93	-5.32	-12.28	.89
3	-3.87	-.52	.65	-11.80	2.70

ATTENUATION AT A FREQUENCY OF 1.000E+08 HZ

ROOMS	DIRECTIONS 1	2	3	4	5
1	-.37	-3.52	-.42	-2.09	2.83
2	-2.92	-6.51	-4.03	-5.75	-.45
3	-1.98	-3.33	-.78	-3.75	2.07

ATTENUATION AT A FREQUENCY OF 1.000E+09 HZ

ROOMS	DIRECTIONS 1	2	3	4	5
1	-.97	-12.41	-1.36	-.49	2.20
2	1.12	-4.11	-5.40	-12.40	.84
3	-3.92	-1.69	.60	-11.91	2.66

ATTENUATION AT A FREQUENCY OF 1.000E+10 HZ

ROOMS	DIRECTIONS 1	2	3	4	5
1	-1.02	-23.00	-1.42	-1.24	1.90
2	1.07	-14.45	-6.10	-13.56	.41
3	-4.30	-12.02	.21	-13.00	2.30

REVERT. FIELD COMPLETED.
/

Figure 5.11(b). Continuation of figure 5.11(a).

6. EXPERIMENTAL DATA

This chapter comprises reports on building attenuation measurements made by NBS at the Seneca Falls Army Depot, the Sierra Army Depot, and the Naval Training Equipment Center.

6.1 Sierra and Seneca Falls Army Depots

Equipment and personnel were assembled to make measurements of electromagnetic attenuation of three buildings at two sites selected by the Army. These sites were the Sierra Army Depot in Herlong, California, and the Seneca Army Depot in Seneca Falls, New York. The measurements were made according to the Draft Test Plan shown in Appendix 9.1, and are briefly described here. The test plan was modified for each test site by the engineers in charge to conform to any time constraints and to any constraints imposed by the physical layout of the structures. For example, the frequency range was reduced from 180 kHz - 18 GHz to 200 kHz - 10 GHz because it was decided that the additional expense involved was not justified by the present needs of the Army. Although the draft test plan recommends four physical group measurements, on the judgment of the engineers in charge, three (or in some cases, two) groups were assumed sufficient to determine the shielding effectiveness of the buildings.

The measurements were conducted over the frequency range of 200 kHz through 10 GHz. The building (No. 672) measured at the Sierra Army Depot was constructed of concrete with a metal barrier inside the wall. Two buildings were measured at the Seneca Falls Army Depot. One (No. 816) was a concrete building with one meter of dirt covering the side of the building and massive steel doors on the ends. The second building (No. 819) was constructed with cement blocks and metal doors for access.

The technique for all the measurements was as follows: a transmitting antenna was placed 30 meters from the building with the transmitted energy being directed perpendicular to the wall of the building. To get a base unattenuated signal the receiving system measured the transmitted signal outside the building at the designated frequency. The same receiving system was then used inside the building to measure the signal attenuation of the building. This signal attenuation (signal inside divided by signal outside, in dB) was measured on a predetermined distance grid within the building. Wherever possible, a $\lambda/4$ (one-quarter wavelength) offset measurement was made to detect the possibilities of building resonance effects. The receiving system used to measure these building attenuations was the isotropic antenna system developed at the National Bureau of Standards.

The attenuation measurements are summarized in tables 6.1 - 6.4 and are plotted in figures 6.1, 6.2, 6.2 and 6.4. The dimensions and physical layouts of the buildings are shown in figures 6.5, 6.6 and 6.7. The tables list the locations, the frequencies of the test, the mean values of attenuation measured, and

uncertainties of the measurement (one standard deviation) shown in parentheses. Computation of the standard deviation is treated in Appendix 9.1.

6.2 Naval Training Equipment Center (NTEC)

Measurements were made of electromagnetic attenuation of three shelters connected together as a training module. The test site was located at NTEC in Orlando, Florida. The measurements were made according to the test plan shown in Appendix 9.1 and are briefly described here. The test plan was modified at the test site by the engineers in charge to conform to any constraints imposed by time or by the physical layout of the test areas.

The measurements were conducted over the frequency range of 35 MHz up to 18 GHz. As shown in figure 6.8, two ground level transmitter locations (labeled 1 and 2) were used. A third location, with the transmitter placed on the roof of an adjacent building, was used to simulate transmissions from above. The following procedure was used for all measurements. The transmitter was placed at one of the locations and was set to operate at the desired frequency and power level listed in the test plan. The receiving antenna was then placed 5 meters outside the building to measure a reference field strength. The receiving antenna was then placed inside Room 1 at the various locations shown in the test plan for the particular frequency. The attenuation (in dB) was then calculated as the measured field strength inside divided by the measured reference field strength outside. In all cases, the receiver electronics were located in Room 2 and were connected to the antennas with electrical cables.

The measured data is shown in tables 6.5 - 6.7 listed by location. The attenuation data is listed as "average", "high", and "low" values for each data point. The first label represents the average of all the data for that location, polarization, frequency, and type of field (magnetic or electric), while the other labels represent the highest and lowest value recorded.

Figures 6.9 - 6.12 show plots of the data where the circles represent electric field attenuation, while the squares represent magnetic field attenuation. The high and low values listed in the tables are shown as horizontal bars above and below each circle or square. When it would be overlapped by the size of the circle or square, the horizontal bar is not shown.

Table 6.1. EM Attenuation of Building No. 672 at Sierra Army Depot

Frequency MHz	Building Attenuation*, dB Electric Field	Magnetic Field
0.2	36 (2)	24 (3)
4	34 (5)	33 (2)
14	27 (4)	
28	33 (4)	
50	39 (6)	
140	37 (5)	
200	27 (4)	
401	22 (4)	
751	29 (3)	
998	28 (3)	
1008	27 (4)	
2000	26 (5)	
4008	39 (5)	
8007	34 (3)	

*Uncertainties representing one standard deviation are shown in parentheses.

Table 6.2. EM Attenuation of Building No. 816, End Wall at Seneca Falls, New York

Frequency MHz	Building Attenuation*, dB Electric Field	Magnetic Field
0.2	46 (6)	33 (14)
4	54 (7)	
15	57 (7)	
30	51 (8)	
50	33 (7)	
100	44 (5)	
200	44 (5)	
400	48 (13)	
750	50 (6)	
1000	45 (7)	
2000	45 (7)	
4000	42 (5)	
8000	55 (8)	

*Uncertainties representing one standard deviation are shown in parentheses.

Table 6.3. EM Attenuation of Building No. 816, Side Wall at Seneca Falls, New York

Frequency MHz	Building Attenuation*, dB Electric Field	Magnetic Field
0.2	56 (2)	50 (9)
4	49 (2)	
15	53 (4)	
30	62 (4)	
50	60 (5)	
100	56 (7)	
500	65 (12)	
1000	63 (7)	
8000	> 83†	
10,000	> 83†	

*Uncertainties representing one standard deviation are shown in parentheses.
†No measurable signal levels with available equipment.

Table 6.4. EM Attenuation of Building No. 819, End Wall at Seneca Falls, New York

Frequency MHz	Building Attenuation*, dB Electric Field	Magnetic Field
0.2	21 (3)	24 (4)
4	18 (7)	16 (5)
15	16 (2)	
30	19 (4)	
50	4 (4)	
100	10 (7)	
200	13 (7)	
500	13 (4)	
750	14 (3)	
1000	23 (4)	
4000	24 (4)	
8000	34 (18)	
10,000	35 (3)	

*Uncertainties representing one standard deviation are shown in parentheses.

Table 6.5. Attenuation measured with launch antenna at location 1, NTEC

Frequency GHz	Vertical Polarization: Electric Field Attenuation (dB) Average	High	Low	Vertical Polarization: Magnetic Field Attenuation (dB) Average	High	Low	Horizontal Polarization: Electric Field Attenuation (dB) Average	High	Low
0.0035	-34	-43	-25	-38	-43	-34			
0.007	-23	-29	-18	-27	-33	-21			
0.014	-42	-42	-41	-45	-46	-44			
0.028	-43	-49	-37	-43	-46	-40			
0.054	-26	-26	-26						
0.088	-17	-18	-15						
0.14	-15	-16	-13				-16	-18	-14
0.20	-19	-21	-16				-13	-15	-11
0.40	-23	-25	-18				-10	-15	- 5
0.75	-20	-23	-19				-31	-31	-30
1.0	-10	-16	- 0				-10	-13	- 7
2.0	- 7	- 8	- 5				- 7	- 8	- 4
8.0	-37	-38	-35				-23	-26	-20
12.0									
18.0	-11	-11	-11				-13	-15	-12

Table 6.6. Attenuation measured with launch antenna at location 2, NTEC

Frequency GHz	Vertical Polarization: Electric Field Attenuation (dB)			Vertical Polarization: Magnetic Field Attenuation (dB)			Horizontal Polarization: Electric Field Attenuation (dB)		
	Average	High	Low	Average	High	Low	Average	High	Low
0.0035	-22.5	-25	-20	-21	-21	-20			
0.007	-30	-40	-21	-20	-20	-19			
0.014	-27	-28	-26	-25	-27	-23			
0.028	-28	-33	-22	-26	-34	-18			
0.054	-32	-39	-25						
0.088	-13	-17	-10						
0.14	- 6	- 8	- 1				-13	-14	-11
0.20	- 7	-10	- 5				-17	-19	-14
0.40	-12	-14	-10				- 7	-11	- 4
0.75	-13	-16	-11				-18	-20	-16
1.0	-22	-24	-21				-20	-26	-17
2.0	-31	-34	-27				-22	-26	-19
8.0	-17	-17	-16				-19	-20	-18
12.0	-13	-24	- 1				-15	-21	- 9
18.0									

Table 6.7. Attenuation measured with launch antenna at location 3 (roof), NTEC

Frequency GHz	Vertical Polarization: Electric Field Attenuation (dB)			Horizontal Polarization: Electric Field Attenuation (dB)		
	Average	High	Low	Average	High	Low
8.0	-20	-22	-18	-20	-22	-17

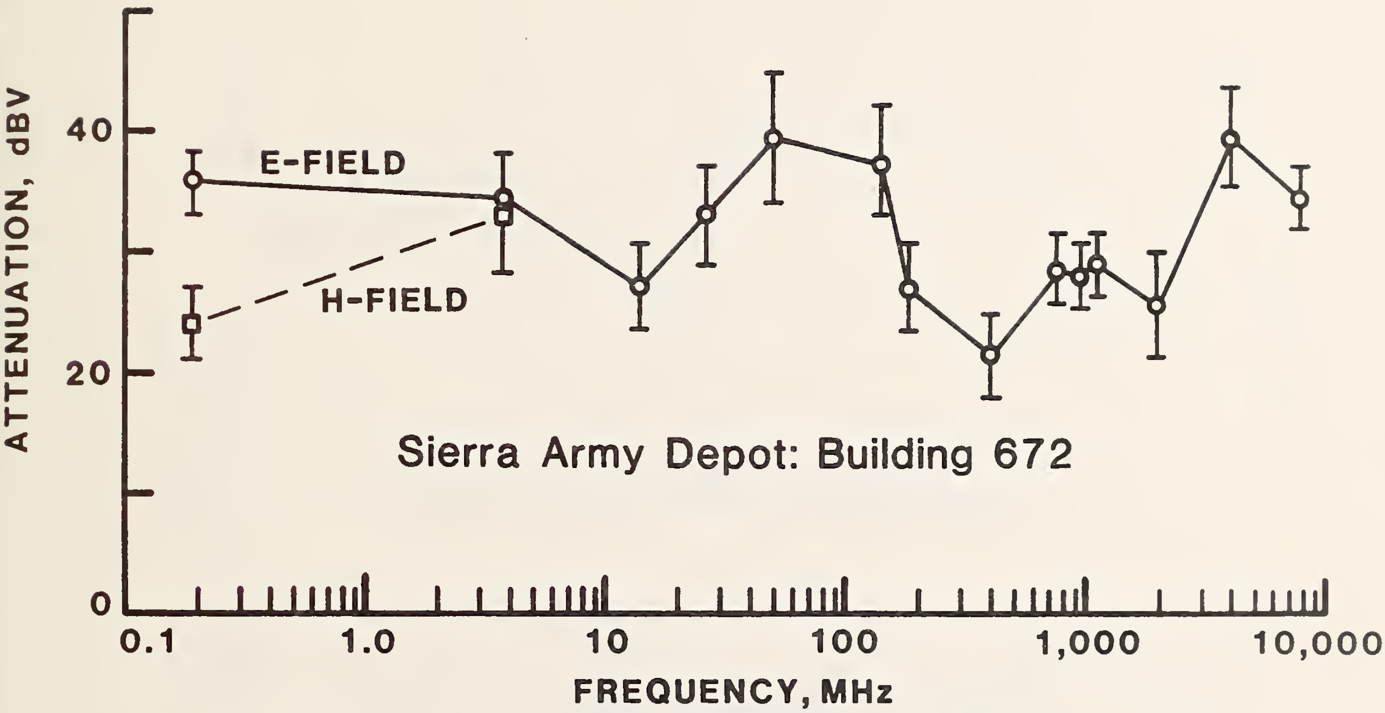


Figure 6.1. Electromagnetic attenuation versus frequency of Building No. 672 at Sierra Army Depot. Electric field attenuation (open circles) was measured from Ø.2 - 1Ø,ØØØ MHz while magnetic field (boxes) was measured at Ø.2 and 4 MHz. Error bars represent one standard deviation. See figure 6.5 for locations of transmitter and receivers.

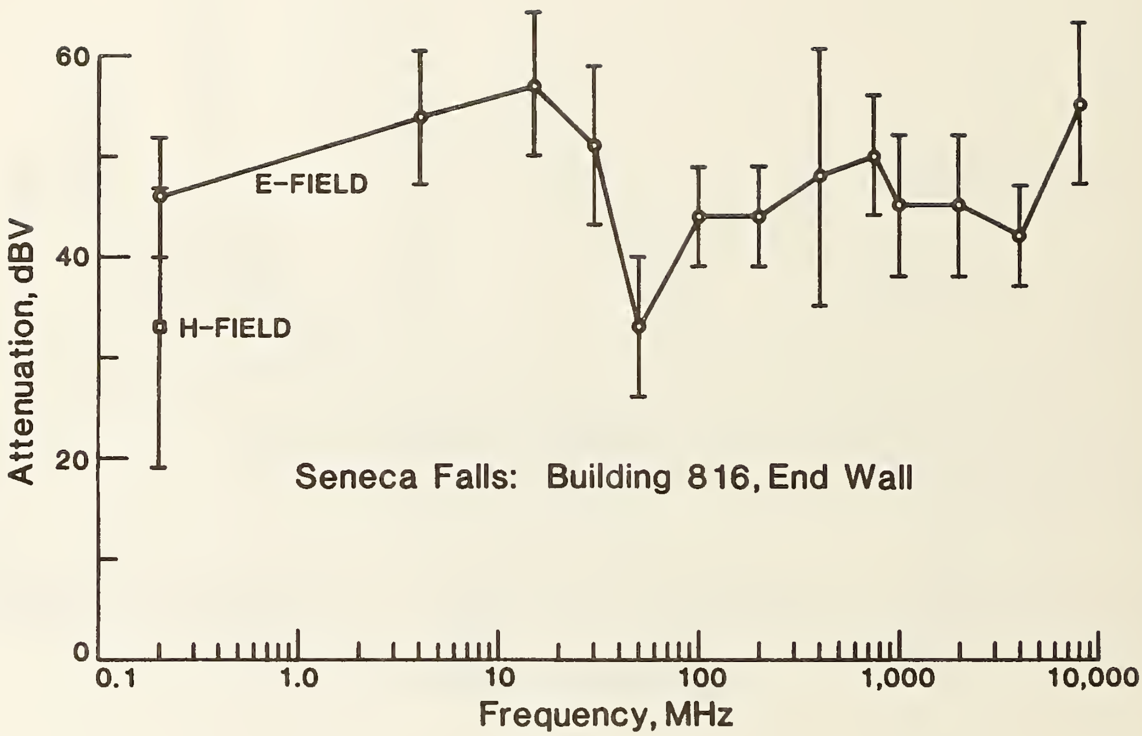


Figure 6.2. Electromagnetic attenuation versus frequency for Building No. 816 at Seneca Falls. The data are plotted as figure 6.1. For this scan, the transmitter was located at the "End Wall" as shown in figure 6.6.

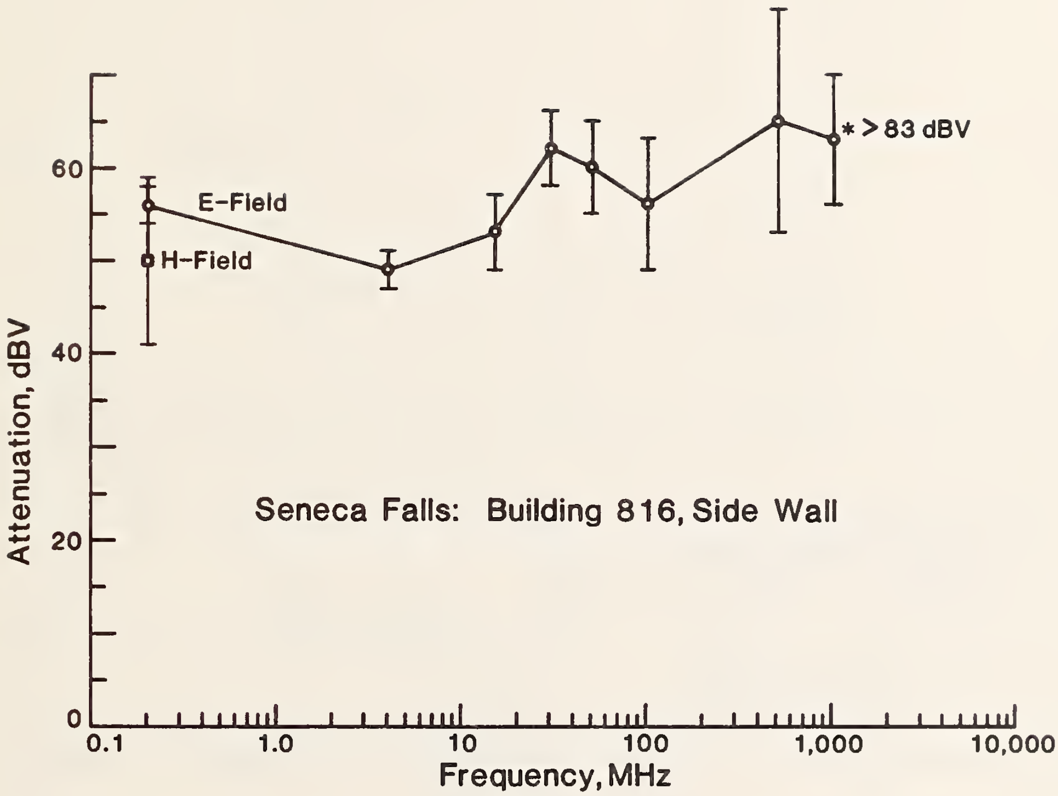


Figure 6.3. Electromagnetic attenuation versus frequency for Building No. 816 at Seneca Falls. The data are plotted as in figure 6.1. For this scan, the transmitter was located at the "Side Wall" as shown in figure 6.6. Magnetic field attenuation was measured at Ø.2 MHz, only.

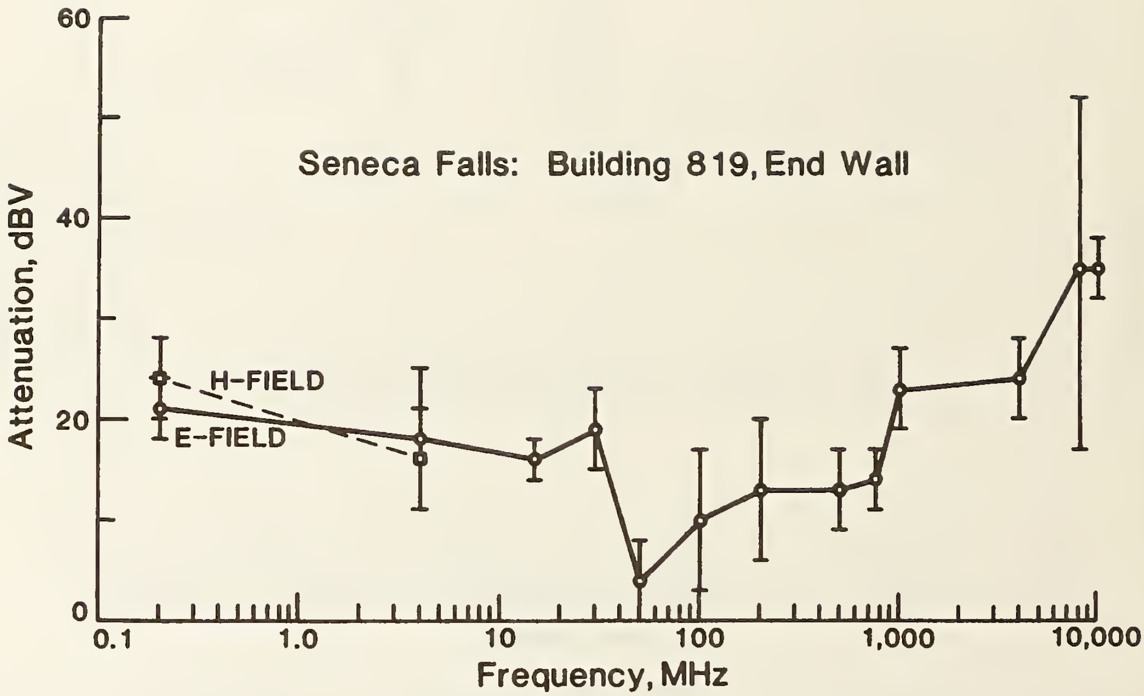


Figure 6.4. Electromagnetic attenuation versus frequency for Building No. 819 at Seneca Falls. The data are plotted the same as in figure 6.1. The transmitter and receiver locations are shown in figure 6.7. Magnetic field attenuation was measured at Ø.2 and 4 MHz.

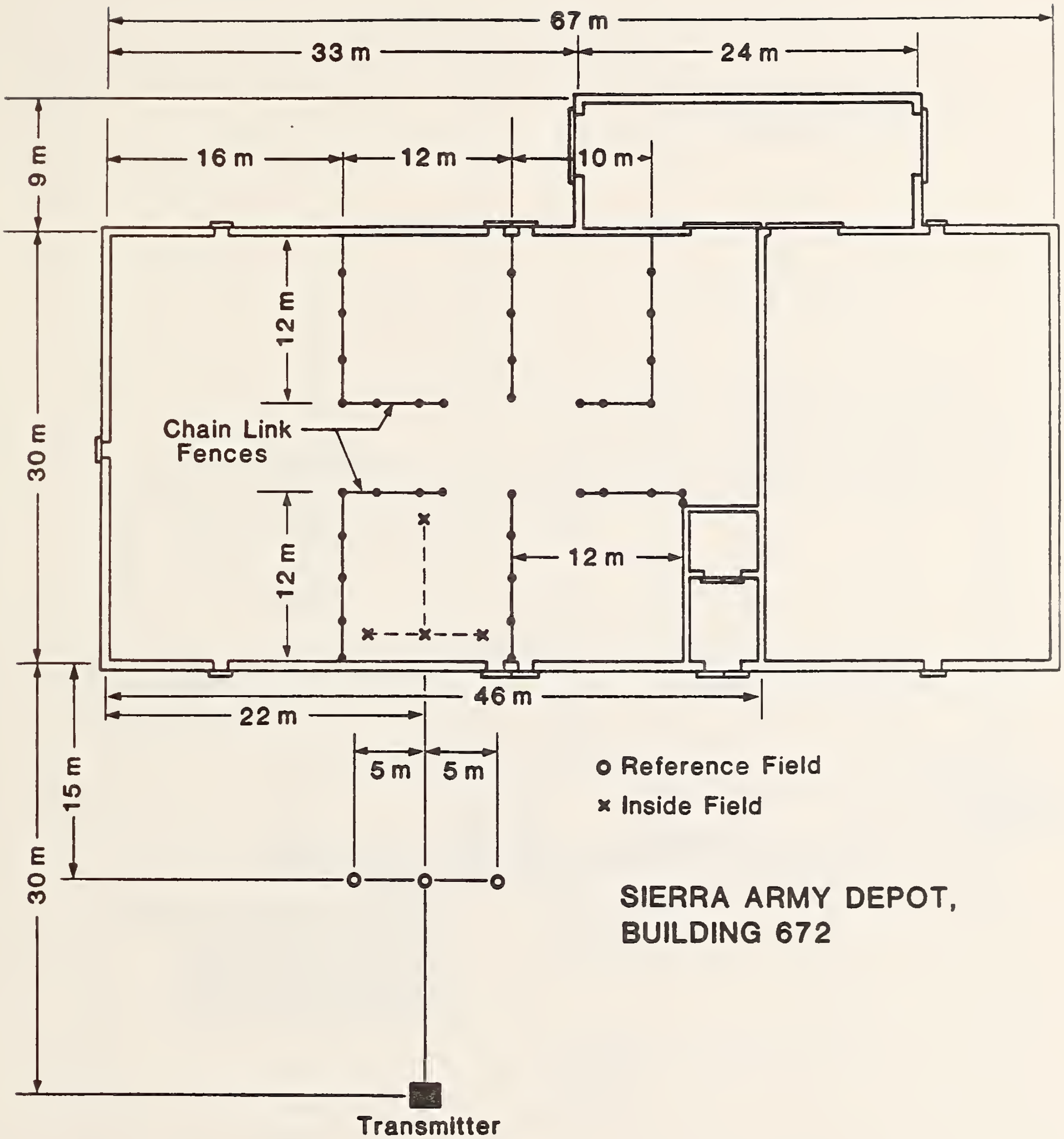


Figure 6.5. Physical layout of Building No. 672 at Sierra Army Depot. The transmitter is located 30 meters from the building and is shown as a square box. Outside reference fields were measured 15 meters from the building at the locations marked with open circles. One row and one column of inside measurements were made at the locations marked by two dashed lines with x's. Measurements are made at one meter intervals along the dashed line.

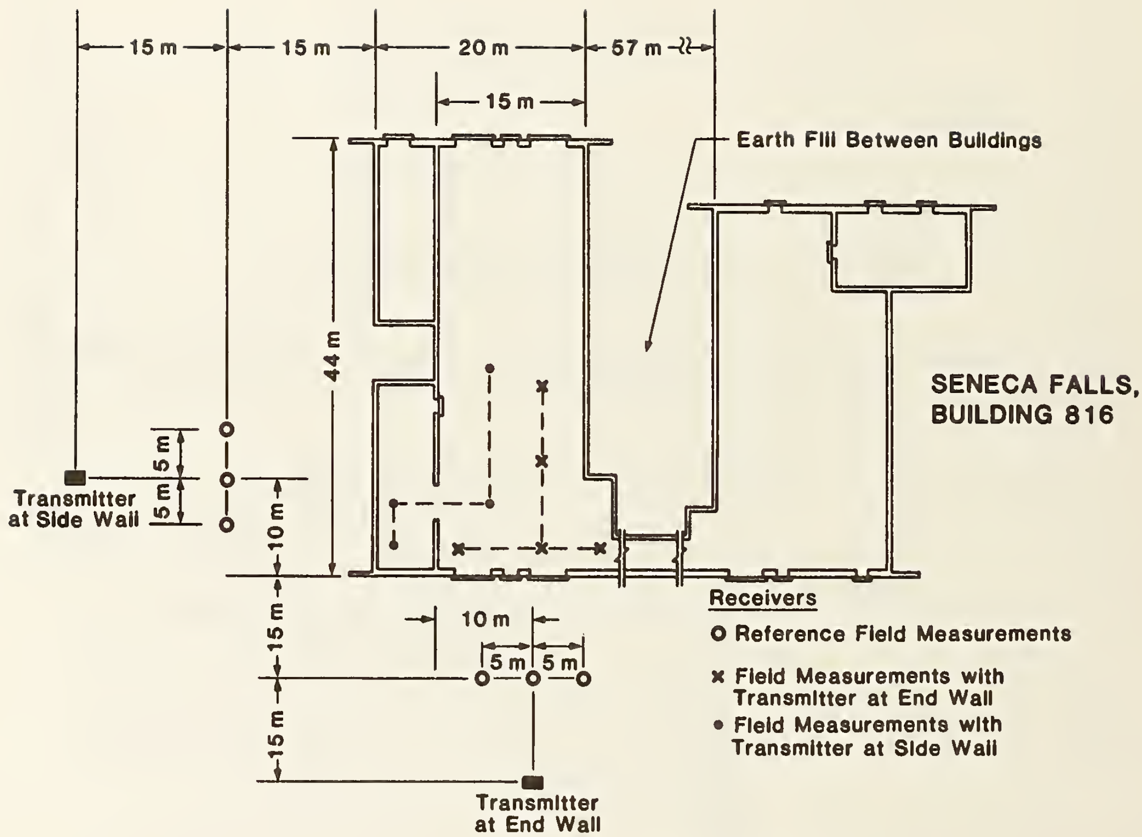


Figure 6.6. Physical layout of Building No. 816 at Seneca Falls. For this site, two sets of data were taken with the transmitter located at the two boxes marked on the drawing. Reference, outside measurements were taken at the locations marked with open circles while inside measurements were taken along the dashed line. For the end wall transmitter location, inside measurements were taken at the locations marked with x's; while the side wall transmitter measurements are marked with closed circles. Measurements are made at one meter intervals along the dashed lines.

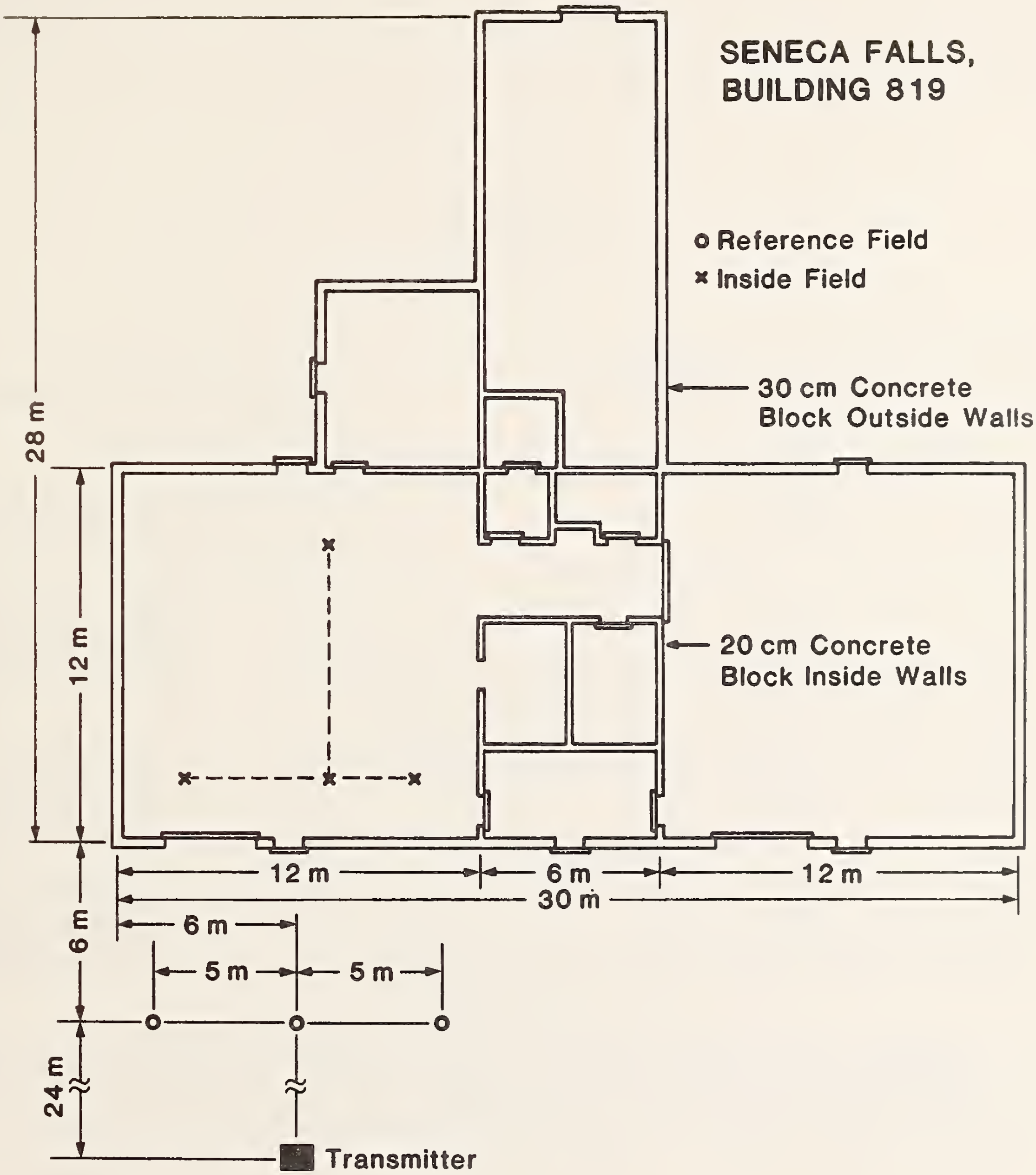


Figure 6.7. Physical layout of Building No. 819 at Seneca Falls. The transmitter is located at the solid box marked on the drawing, while the outside reference points are shown as open circles. The inside measurement points are located along the dashed lines with the x's marked. Measurements are made at one meter intervals along the dashed lines.

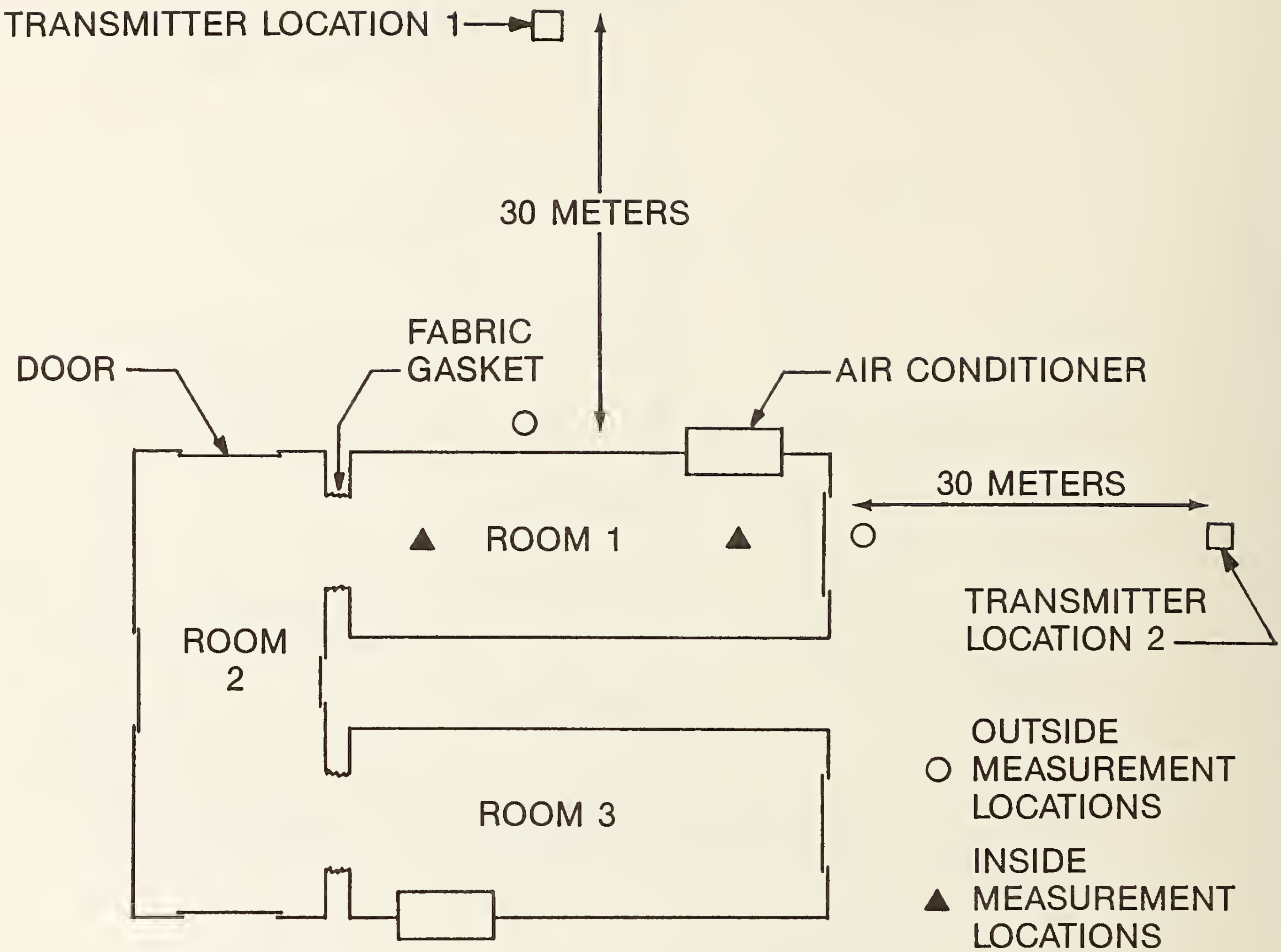


Figure 6.8. Building layout of training module at NTEC. The physical arrangement of the three attached buildings are shown along with the two transmitter locations (boxes). Air conditioning units are labeled "A.C.". A rubber shroud or gasket is used to attach the rooms together.

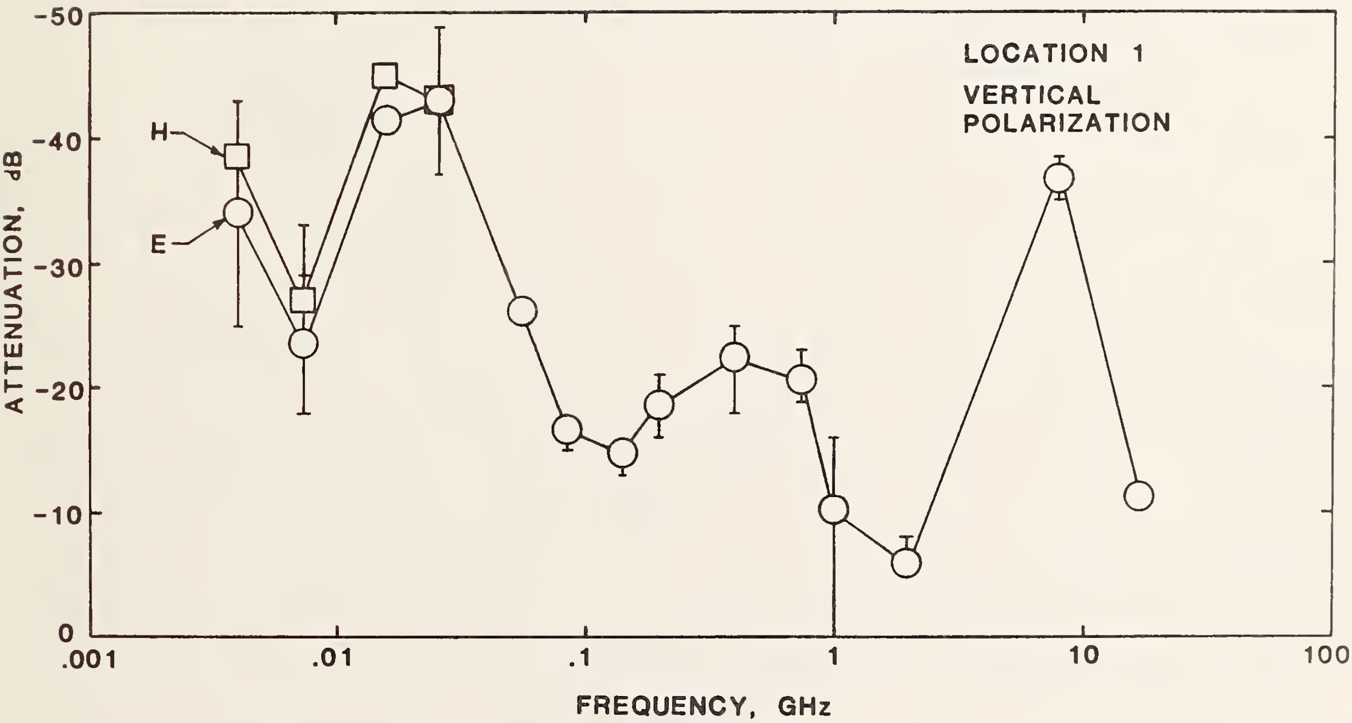


Figure 6.9. Building attenuation versus frequency of training module at NTEC. This graph shows the data for transmitter location 1 with vertical polarization launched. The circles represent average electric field attenuation, while the average magnetic field attenuation is shown as a square. The limit bars represent the highest and lowest attenuation observed at each frequency.

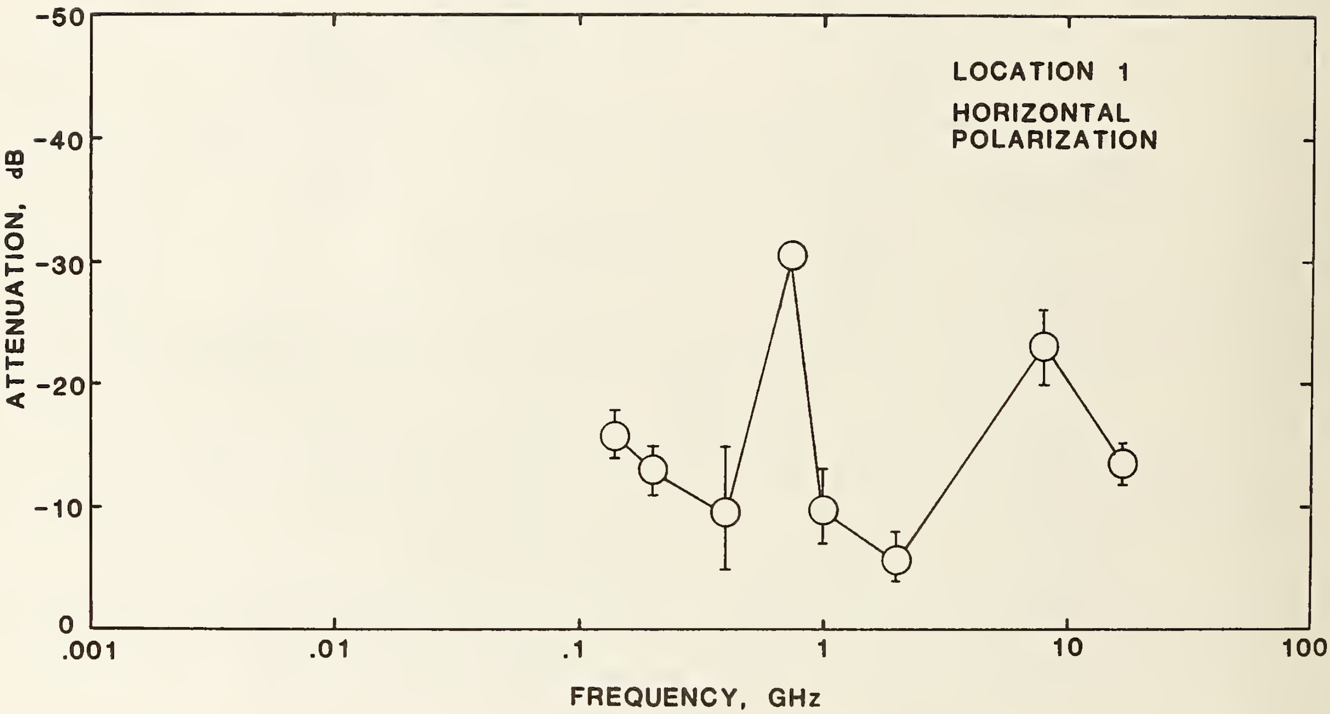


Figure 6.10. Building attenuation versus frequency of training module at NTEC. This graph shows the data for transmitter location 1 with horizontal polarization launched. The circles represent the average electric field attenuation, while the limit bars represent the highest and lowest attenuations observed at each frequency.

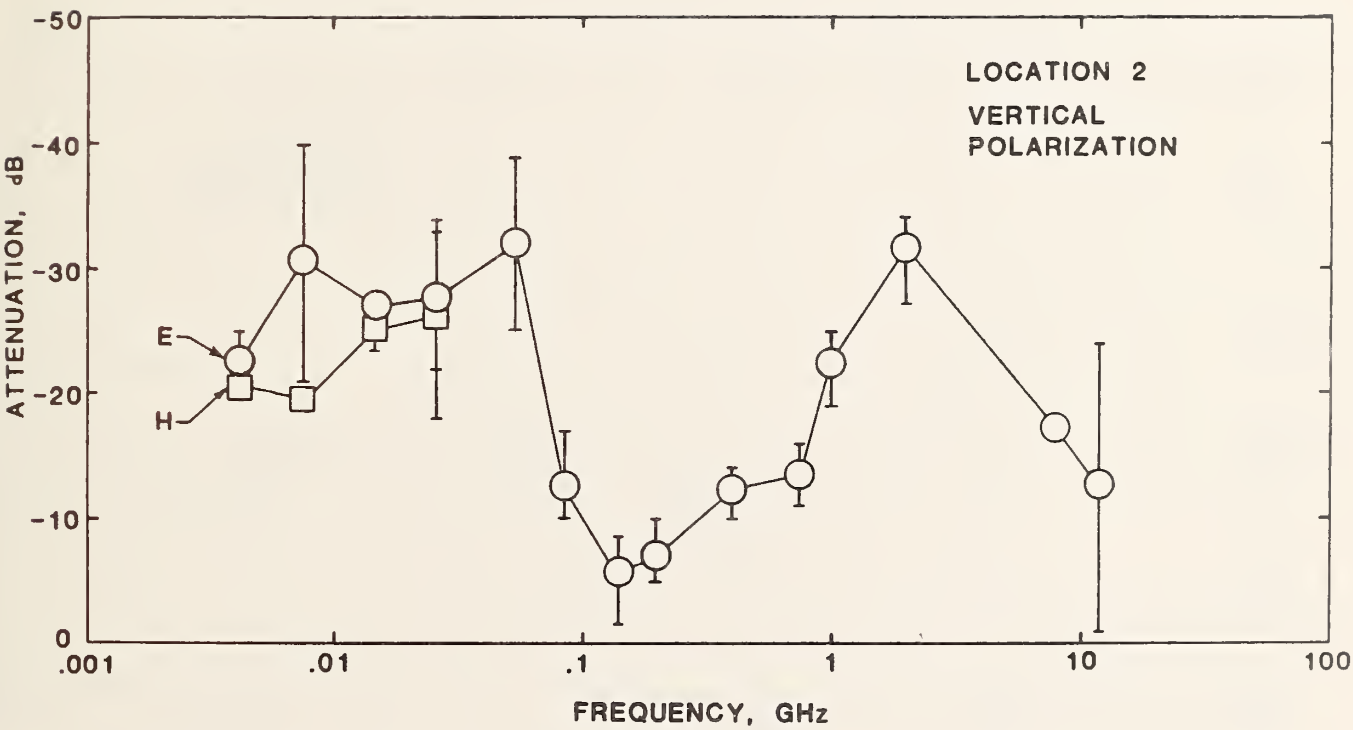


Figure 6.11. Building attenuation versus frequency of training module at NTEC. This graph shows the data for transmitter location 2 with vertical polarization launched. The circles represent average electric field attenuation, while the average magnetic field attenuation is shown as a square. The limit bars represent the highest and lowest attenuations observed at each frequency.

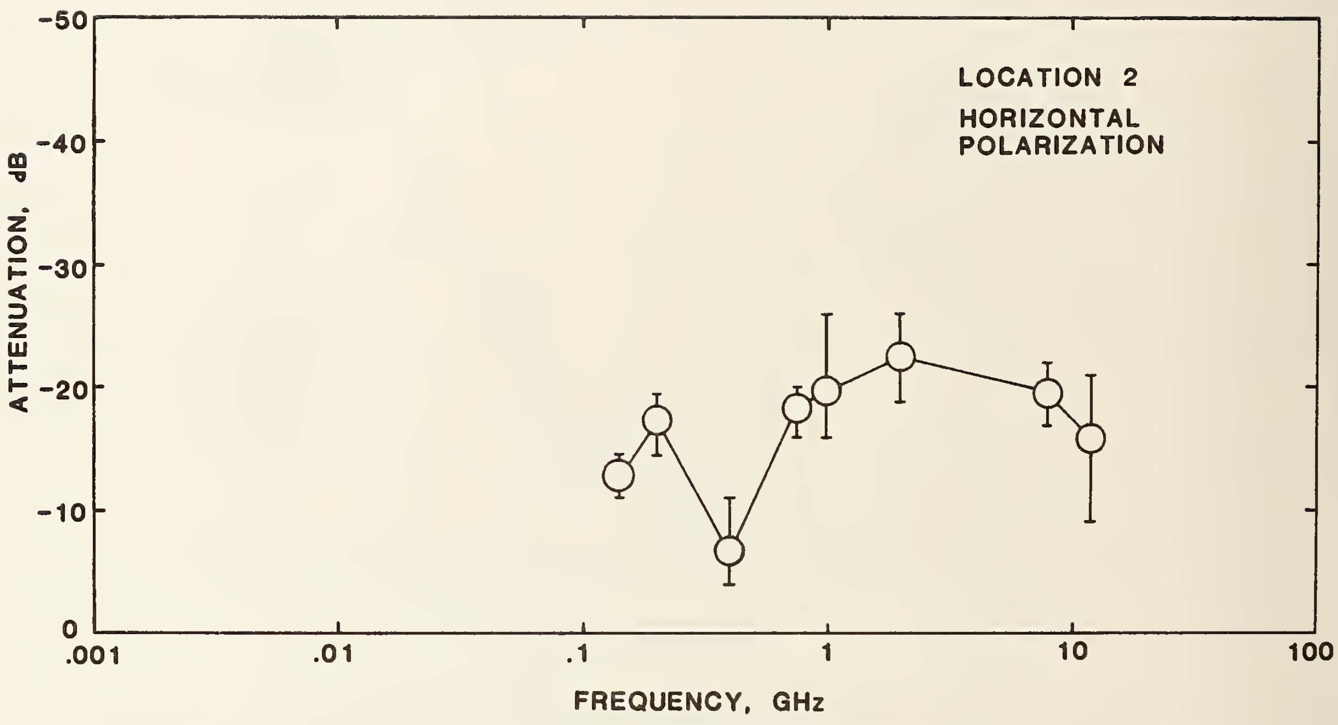


Figure 6.12. Building attenuation versus frequency of training module at NTEC. This graph shows the data for transmitter location 2 with horizontal polarization launched. The circles represent the average electric field attenuation, while the limit bars represent the highest and lowest attenuation observed at each frequency.

7. COMPUTER RESULTS AND CONCLUSIONS

7.1 Comparison With Experimental Results

To test the validity of the computer calculation of building attenuation, the program was run for a building that had been measured experimentally for electromagnetic shielding effectiveness. The structure chosen for comparison was the training module located at the Naval Training Equipment Center (NTEC) in Orlando, Florida. The experimental measurements of shielding effectiveness are already described in Section 6.2 of this report.

To input data into the computer program, the training module floor plan shown in figure 6.8, wa redrawn, as shown in figure 7.1, to show the details of the walls, windows, and doors, based on observations made at the measurement site. Some assumptions and compromises were also made so that the building could be properly modelled by the computer. Looking at figure 6.8, the main questions were: 1) how to account for the rubber gaskets between the modules. The first question was solved by considering the open space between the modules as a fourth room, or room 4 as shown on figure 7.1. The walls were taken as MØ1 ("NULL MATERIAL") and windows of material MØ1 with a metal frame (M12 (STEEL)) were added on the three ends of the room. The "T" shape of ROOM Ø4 was created by using two rectangular shaped volumes and giving them the same name. For example, look at the last two data entry lines of the first table in figure 7.2(a) and notice that room 4 has two ceiling sections, one with dimensions 6.1Ø x 1.22 m and the second with 6.1Ø x Ø.15 m. The three windows, DA, DB and DB, shown in the figure were added so that the input resonance condition described in Section 3.5 would be taken into account.

The air conditioners (question 2) were considered closed doors in the model ("DC" on the diagram). The rubber gaskets (question 3) were modelled by ignoring them. They should have no shielding effectiveness for electromagnetic radiation.

When the experimental measurements were made on the shelter, some of the exterior doors were left open to provide ventilation for the equipment from the hot and humid conditions. Those doors, marked "DO" in figure 7.1, are modelled as "open" for the computer program so that the calculations can be properly compared with the experimental results. (Experimentally it was found that opening the doors had less than a 2 dB effect on the measurements. Since equipment failure was experienced with the doors closed, and since the experimental uncertainty was typically greater than 2 dB, the engineers in charge of the measurement made the decision to leave those doors open.)

The computer print-out for the calculation is shown in figure 7.2 (a-d). The first three tables list the wall data file B2Ø4W, the hole data file B2Ø4H, and hole types data file B204T. The next thirteen tables list the attenuation of each room (1-4) for each direction of input (1-5) for frequencies in the range of 1.Ø MHz to 1Ø GHz. In figures 7.3-7.6, the experimental data (open circles and squares)

is compared to the calculated data (closed triangles) where transmitter location 1 corresponds to computer direction D1, and transmitter location 2 corresponds to computer direction D2. Since experimental measurements were made only for room 1, the calculated data is displayed for just room 1.

By symmetry, a field projected from direction D3 should yield identical results with a field projected from D1. This is evident in the attenuation tables of figure 7.2 (a-d) where the column corresponding to D3 is identical with the results shown in the first column, D1. The fourth column, D4, is -60 dB at all frequencies and for all rooms. This is caused by the fact that the wall facing direction D4 has no openings which will allow penetration. Since that wall "shadows" all the other rooms, and since the computer model does not include external diffraction around corners, all of the rooms will have a -60 dB attenuation factor for direction D4. In figure 7.7, the room and door resonances of the test structure are shown. In the 0.1 GHz range the room resonance and door resonance for door "DO" dominate and drop the attenuation factor to zero. (Where the computer model calculated gain for a room, the attenuation factor was taken to be zero.) This effect was equally strong for both directions D1 and D2 and can be seen in figures 7.3 and 7.4. At around 1.0 GHz, the dominant resonant effect is due to door "DB". Since this door is only illuminated from direction D1, the calculated attenuation at 1.0 GHz is reduced for direction D1 (fig. 7.3) but not for direction D2 (fig. 7.4). This is in good agreement with the corresponding experimental measurements for those directions.

Overall, the fit between the calculated and experimental results are in good agreement. Given just the calculated data, it would be possible to estimate the shielding effectiveness of the training modules.

7.2 Recommendation for Further Work

One area in the model that could use further development is in the resonance calculations. The present approach essentially turns the resonances "on" or "off" and does not use any sophisticated techniques to properly weight the resonant effects. It should be possible to incorporate more advanced resonant models into the program. That task should be addressed in future work.

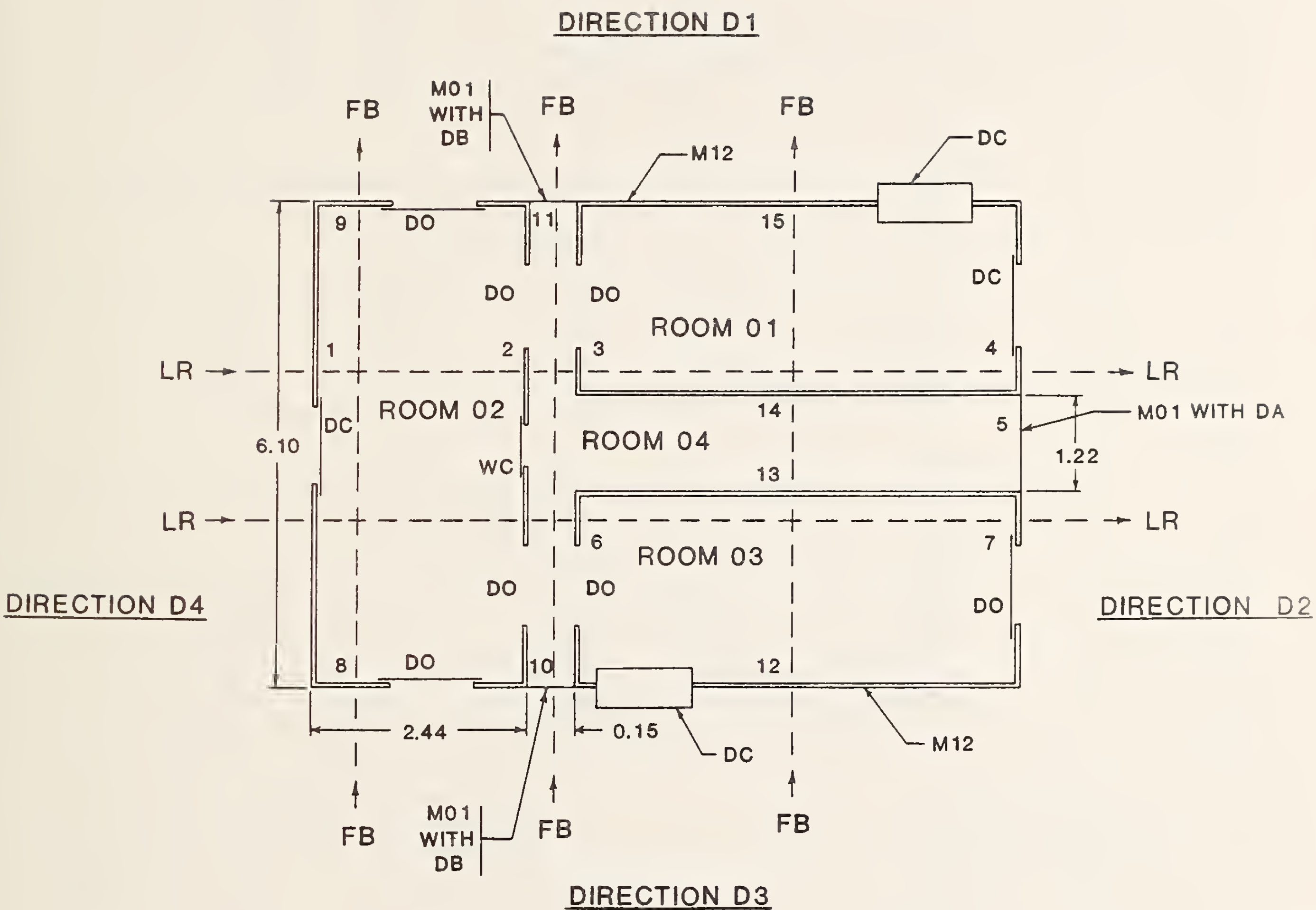


Figure 7.1. Building layout of training modules used for comparison of calculated versus experimental data. Notice that the air gap between the modules is considered "Room Ø4" for the computer model.

```
ENTER BUILDING IDENTIFICATION  (E.G. '101')
    (NO MORE THAN 5 ALPHANUMERIC CHARACTERS)
? '204'
BUILDING IDENTIFICATION ENTERED AS '204'
ENTER NUMBER OF ROOMS IN BUILDING
? 4
```

WALL IDENTIFICATION			WALL PARAMETERS			
DIR	FROM	TO	MATERIAL	HEIGHT	WIDTH	THICKNESS
LR	D4	02	M12	2.44	6.10	.20
LR	02	04	M12	2.44	6.10	.20
LR	04	01	M12	2.44	2.44	.20
LR	01	D2	M12	2.44	2.44	.20
LR	04	D2	M01	2.44	1.22	.20
LR	04	03	M12	2.44	2.44	.20
LR	03	D2	M12	2.44	2.44	.20
FB	D3	02	M12	2.44	2.44	.20
FB	02	D1	M12	2.44	2.44	.20
FB	D3	04	M01	2.44	.15	.20
FB	04	D1	M01	2.44	.15	.20
FB	D3	03	M12	2.44	6.10	.20
FB	03	04	M12	2.44	6.10	.20
FB	04	01	M12	2.44	6.10	.20
FB	01	D1	M12	2.44	6.10	.20
UD	D5	01	M12	6.10	2.44	.20
UD	D5	02	M12	6.10	2.44	.20
UD	D5	03	M12	6.10	2.44	.20
UD	D5	04	M01	6.10	1.22	1.00
UD	D5	04	M01	6.10	.15	1.00
UD	01	D6	M12	6.10	2.44	.20
UD	02	D6	M12	6.10	2.44	.20
UD	03	D6	M12	6.10	2.44	.20
UD	04	D6	M01	6.10	1.22	1.00
UD	04	D6	M01	6.10	.15	1.00

DOOR AND WINDOW LOCATIONS

	WALL IDENTIFICATION		
ID	DIRECTION	FROM	TO
DC	LR	D4	02
DO	LR	02	04
DO	LR	04	01
DC	LR	01	D2
WC	LR	02	04
DA	LR	04	D2
DO	LR	02	04
DO	LR	04	03
DO	LR	03	D2
DC	FB	D3	03
DO	FB	D3	02
DO	FB	02	D1
DE	FB	D3	04
DB	FB	04	D1
DC	FB	01	D1

Figure 7.2(a). Computer print-out of calculations of electromagnetic shielding effectiveness for building shown in figure 7.1.

DOOR AND WINDOW PARAMETERS

ID	MATERIAL	FRAME MATERIAL	HEIGHT	WIDTH	LAYER THICKNESS	DISTANCE ABOVE FLR
DA	M01	M12	2.44	1.22	.20	0.00
DB	M01	M12	2.44	.15	.20	0.00
DC	M12	M12	1.76	1.22	.20	0.00
DO	M01	M12	1.76	1.22	.20	0.00
WC	M12	M12	.61	.46	.20	0.00
WA	M10	M12	1.76	1.22	.20	0.00

ATTENUATION AT A FREQUENCY OF 1.000E+06 HZ

ROOMS	DIRECTIONS 1	2	3	4	5
1	-32.42	-23.59	-32.42	-60.00	-28.73
2	-6.96	-23.31	-6.96	-60.00	-28.45
3	-35.71	-7.48	-35.71	-60.00	-32.03
4	-12.73	-3.91	-12.73	-60.00	-9.05

ATTENUATION AT A FREQUENCY OF 2.000E+06 HZ

ROOMS	DIRECTIONS 1	2	3	4	5
1	-32.42	-23.59	-32.42	-60.00	-28.73
2	-6.96	-23.31	-6.96	-60.00	-28.45
3	-35.71	-7.48	-35.71	-60.00	-32.03
4	-12.73	-3.91	-12.73	-60.00	-9.05

ATTENUATION AT A FREQUENCY OF 5.000E+06 HZ

ROOMS	DIRECTIONS 1	2	3	4	5
1	-32.42	-23.59	-32.42	-60.00	-28.73
2	-6.96	-23.31	-6.96	-60.00	-28.45
3	-35.71	-7.48	-35.71	-60.00	-32.03
4	-12.73	-3.91	-12.73	-60.00	-9.05

ATTENUATION AT A FREQUENCY OF 1.000E+07 HZ

ROOMS	DIRECTIONS 1	2	3	4	5
1	-32.42	-23.59	-32.42	-60.00	-28.73
2	-6.96	-23.31	-6.96	-60.00	-28.45
3	-35.71	-7.48	-35.71	-60.00	-32.03
4	-12.73	-3.91	-12.73	-60.00	-9.05

Figure 7.2(b). Computer print-out of calculations of electromagnetic shielding effectiveness for building shown in figure 7.1.

ATTENUATION AT A FREQUENCY OF 2.000E+07 HZ

ROOMS	DIRECTIONS 1	2	3	4	5
1	-32.42	-23.59	-32.42	-60.00	-28.73
2	-6.96	-23.31	-6.96	-60.00	-28.45
3	-35.71	-7.48	-35.71	-60.00	-32.03
4	-12.73	-3.91	-12.73	-60.00	-9.05

ATTENUATION AT A FREQUENCY OF 5.000E+07 HZ

ROOMS	DIRECTIONS 1	2	3	4	5
1	-32.42	-23.59	-32.42	-60.00	-28.73
2	-6.96	-23.31	-6.96	-60.00	-28.45
3	-35.71	-7.48	-35.71	-60.00	-32.03
4	-12.73	-3.91	-12.73	-60.00	-9.05

ATTENUATION AT A FREQUENCY OF 1.000E+08 HZ

ROOMS	DIRECTIONS 1	2	3	4	5
1	5.65	10.41	5.65	-60.00	-15.70
2	9.40	7.51	9.40	-60.00	-18.60
3	2.08	12.18	2.08	-60.00	-19.27
4	6.84	11.60	6.84	-60.00	-14.51

ATTENUATION AT A FREQUENCY OF 2.000E+08 HZ

ROOMS	DIRECTIONS 1	2	3	4	5
1	5.65	10.41	5.65	-60.00	-15.70
2	9.40	7.51	9.40	-60.00	-18.60
3	2.08	12.18	2.08	-60.00	-19.27
4	6.84	11.60	6.84	-60.00	-14.51

ATTENUATION AT A FREQUENCY OF 5.000E+08 HZ

ROOMS	DIRECTIONS 1	2	3	4	5
1	-10.11	-21.00	-10.11	-60.00	-26.14
2	-5.49	-21.78	-5.49	-60.00	-26.92
3	-14.39	-7.39	-14.39	-60.00	-30.42
4	8.51	-2.37	8.51	-60.00	-7.51

Figure 7.2(c). Computer print-out of calculations of electromagnetic shielding effectiveness for building shown in figure 7.1.

ATTENUATION AT A FREQUENCY OF 1.000E+09 HZ

ROOMS	DIRECTIONS 1	2	3	4	5
1	-10.11	-21.00	-10.11	-60.00	-26.14
2	-5.49	-21.78	-5.49	-60.00	-26.92
3	-14.39	-7.39	-14.39	-60.00	-30.42
4	8.51	-2.37	8.51	-60.00	-7.51

ATTENUATION AT A FREQUENCY OF 2.000E+09 HZ

ROOMS	DIRECTIONS 1	2	3	4	5
1	-10.11	-21.00	-10.11	-60.00	-26.14
2	-5.49	-21.78	-5.49	-60.00	-26.92
3	-14.39	-7.39	-14.39	-60.00	-30.42
4	8.51	-2.37	8.51	-60.00	-7.51

ATTENUATION AT A FREQUENCY OF 5.000E+09 HZ

ROOMS	DIRECTIONS 1	2	3	4	5
1	-32.42	-23.59	-32.42	-60.00	-28.73
2	-6.96	-23.31	-6.96	-60.00	-28.45
3	-35.71	-7.48	-35.71	-60.00	-32.03
4	-12.73	-3.91	-12.73	-60.00	-9.05

ATTENUATION AT A FREQUENCY OF 1.000E+10 HZ

ROOMS	DIRECTIONS 1	2	3	4	5
1	-32.42	-23.59	-32.42	-60.00	-28.73
2	-6.96	-23.31	-6.96	-60.00	-28.45
3	-35.71	-7.48	-35.71	-60.00	-32.03
4	-12.73	-3.91	-12.73	-60.00	-9.05

Figure 7.2(d). Computer print-out of calculations of electromagnetic shielding effectiveness for building shown in figure 7.1.

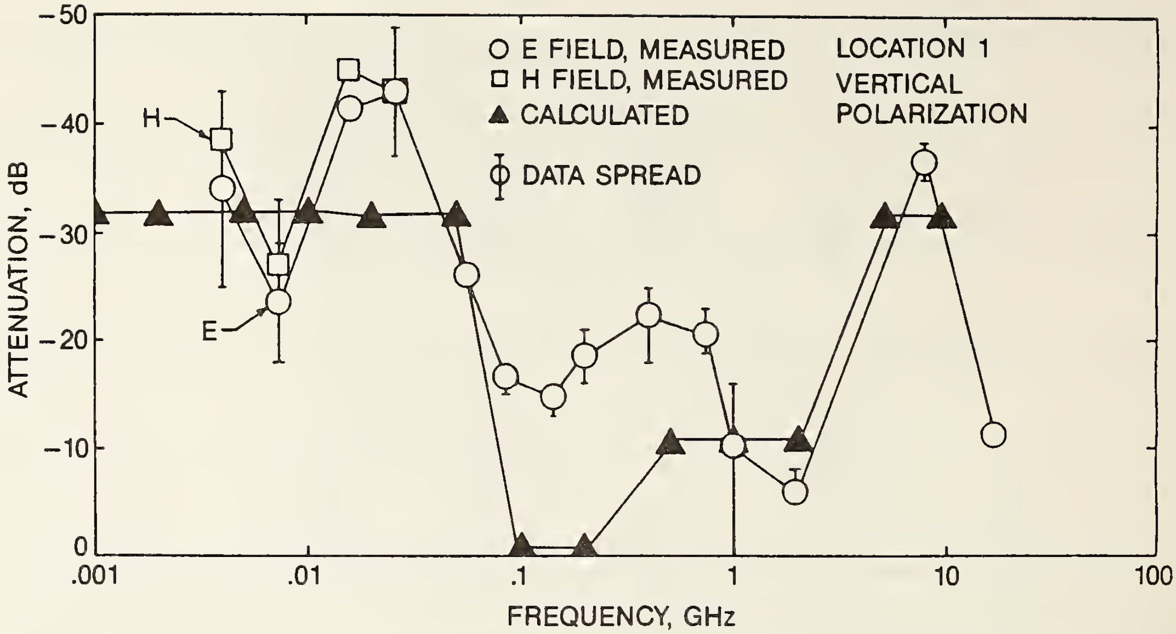


FIGURE 7.3 TRANSMITTER LOCATION 1, VERTICAL POLARIZATION DATA

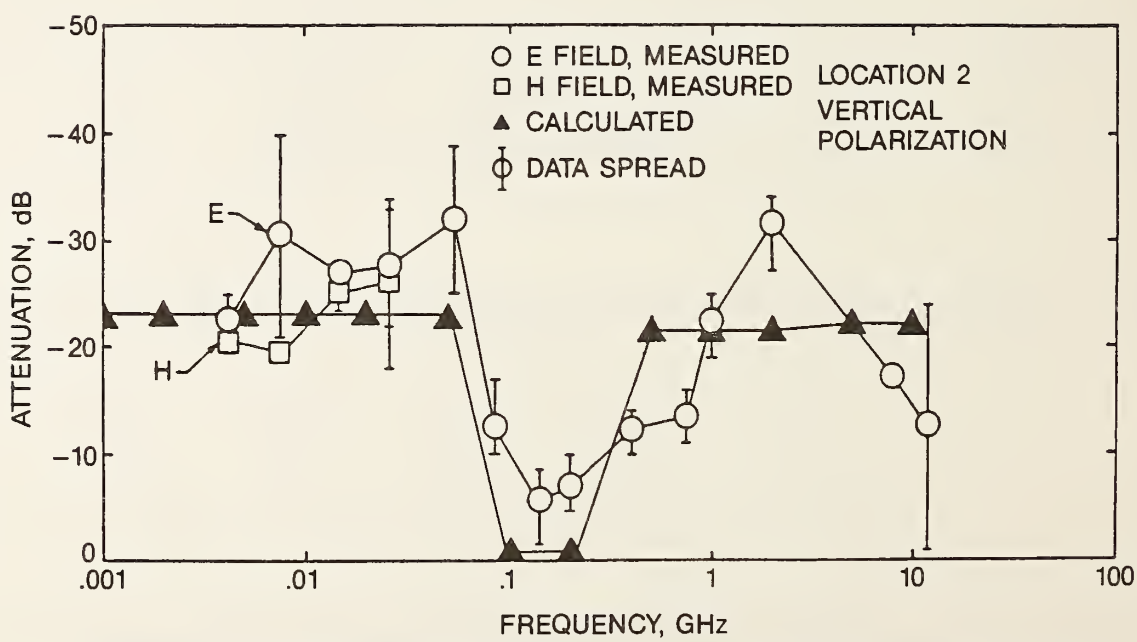


FIGURE 7.4 TRANSMITTER LOCATION 2, VERTICAL POLARIZATION DATA

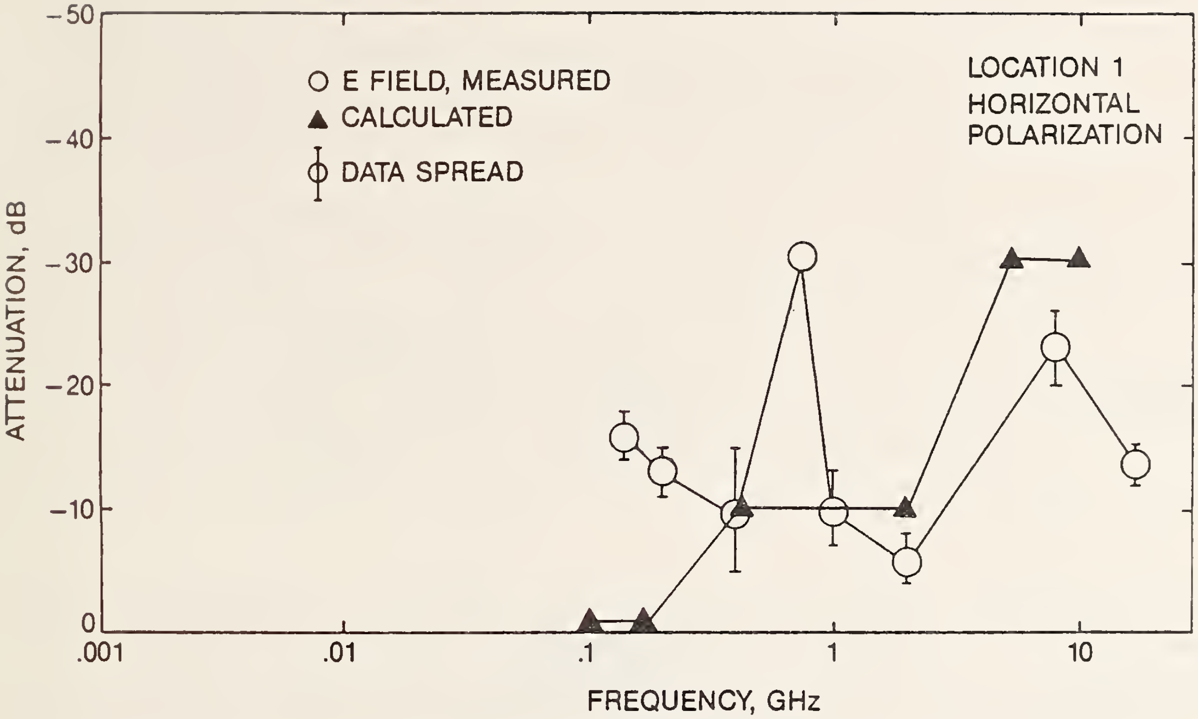


FIGURE 7.5 TRANSMITTER LOCATION 1, HORIZONTAL POLARIZATION DATA

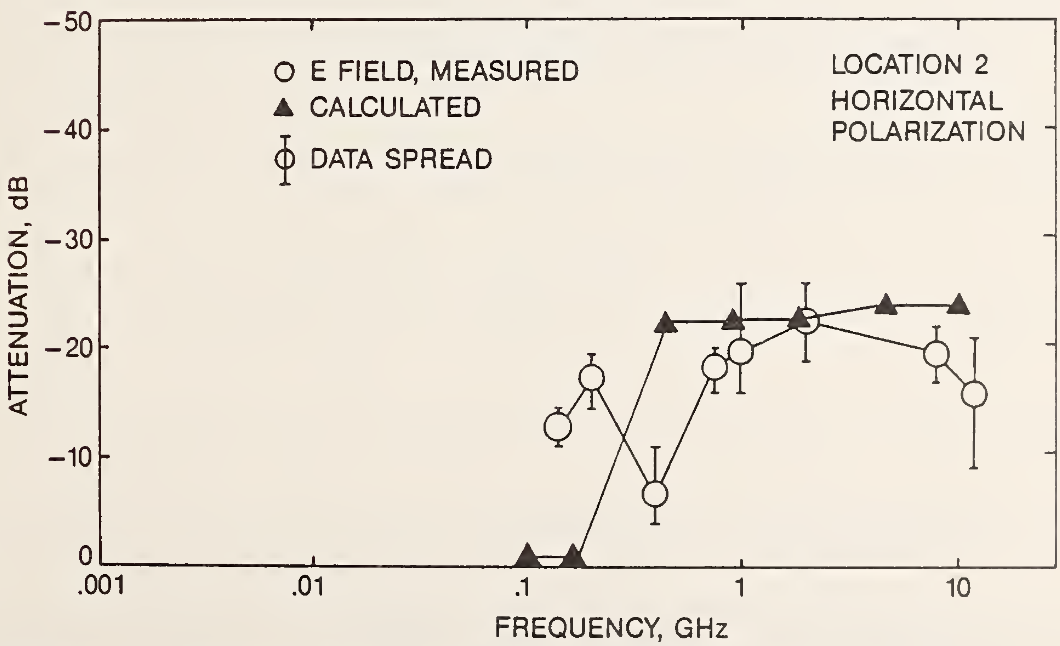


FIGURE 7.6 TRANSMITTER LOCATION 2, HORIZONTAL POLARIZATION DATA

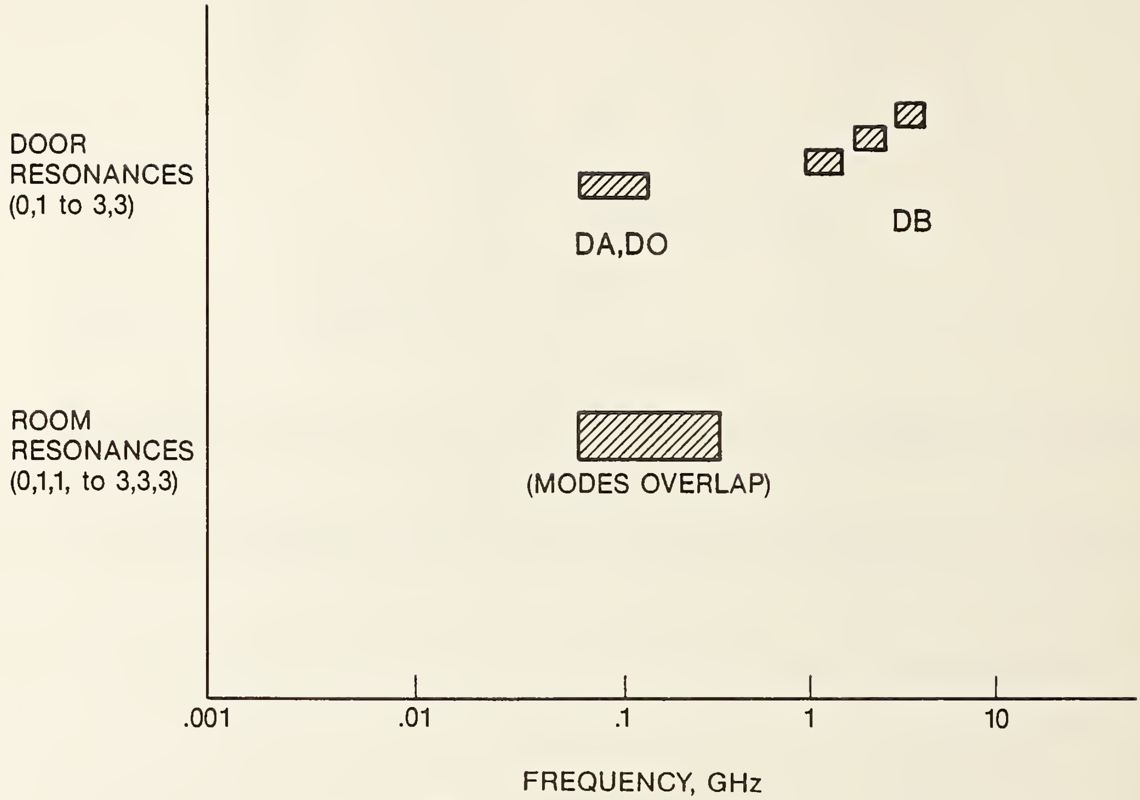


FIGURE 7.7 TEST STRUCTURE ROOM AND DOOR RESONANCES

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APPENDIX 9.1

TEST PLAN

BUILDING ATTENUATION MEASUREMENTS

A.1 Purpose

This plan outlines a method for measuring the attenuation of buildings over all or part of the frequency range covered in this report: 1Ø kHz - 1Ø GHz. In order to compare measured attenuation data with computed data (generated by the computer program developed for this report), the building must be square or rectangular, or made up of adjoining squares or rectangles; and the test signals must be perpendicularly incident on the building walls.

A.2 Frequency Coverage

Apart from limitations imposed by the availability of portable sources and launching antennas, the choice of measurement frequencies may be determined by factors such as

- regions of low attenuation in the computed data.
- the frequencies of strong ambient signals.
- frequencies at which a given device is known to have highest susceptibility.

If there are not worrisome frequencies, the project engineer can make the choice of measurement frequencies over the 1Ø kHz - 1Ø GHz range.

Table A-1 lists the frequencies at which an NBS team made building attenuation measurements on an Army installation. Other columns in the table indicate distance increments between locations on the measurement grid, the type of field to be measured and the type to be launched, and the electric field polarization. A measurement grid is shown in figure A.1 for a single-room building or for a single room within a building, though the size, shape, and construction of a particular building may permit it to be characterized by many fewer measurement locations (see section A.3).

A.3 Number and location of measurements

A.3.1 For a free-standing, rectangular building with a single room, a field will be launched perpendicular to all four faces of the building in turn. Where many rooms exist, only some of which are of interest, or the general building geometry dictates, some of the four faces may not be used.

A.3.2 The exact pattern of measurement location is determined by the frequency and is adaptive. (Ref. figure A.1).

Table A.1. Tabulation of the frequencies and signal properties for a set of electromagnetic field attenuation measurements.

Frequency	Δ, Meters[1,2]	Type of Measurement	Field Launched	Polarization[3]
180 kHz	8	E & H	Primarily H	Vert.
3.5 MHz	8	E & H	E X H	"
7 MHz	4	E	E X H	"
14 MHz	4	E	E X H	"
28 MHz	2	E	E X H	"
54 MHz	2	E	E X H	"
140 MHz	1*	E	E X H	"
200 MHz	1*	E	E X H	"
400 MHz	1*	E	E X H	"
750 MHz	1*	E	E X H	"
1000 MHz	1*	E	E X H	Circular or Horiz.
2000 MHz	1*	E	E X H	"
4000 MHz	1*	E	E X H	"
8000 MHz	1*	E	E X H	"
12000 MHz	1*	E	E X H	"
18000 MHz	1*	E	E X H	"

Notes

1. * Actual position will be varied ± 1/4 meter to achieve highest reading.
2. Δ is spacing of locations for sequence 3 and above.
3. Circular polarization will be used above 1 GHz if adequate signals are received inside building. If signal levels are too low a high gain horizontally polarized launching antenna will be used.

A.3.2.1 First, the incident field is measured 5 meters from the face of the building at three locations as indicated.

A.3.2.2 Next, a 1 meter by 1 meter grid is established in the area to be measured. A line, two meters inside the front wall is measured every meter to within 2 meters of the side walls. This will be called sequence A.

A.3.2.3 The highest reading is noted and a line of points Δ meters apart (see Table A.1), perpendicular to the first line is measured, until a total-field measurement is obtained which is equal to or less than the lowest reading obtained in sequence A. This will be called sequence B. Note, however, if this line of measurements is within ± 3 meters of the center line of the building, this sequence may be eliminated.

A.3.2.4 A line of points Δ meters apart is now measured along the center line of the building to the center of the room. This is called sequence C.

A.3.2.5 If no other faces of the building are to be excited which are perpendicular to the first face, then a last sequence D across the middle of the room will be taken at spacings of Δ meters.

A.3.2.6 If L/Δ or $W/\Delta \leq 5$, (where L & W are dimensions of the room being measured) then at least 5 measurement points will be taken in sequences B, C, and D. The nearest full meter value for Δ will be chosen which will result in at least 5 measurement points within the room's dimensions.

A.3.2.7 All readings will be taken at a height of 1.5 meters except those at 140 MHz when a second set will be taken at a height of 1 meter.

A.3.2.8 Data will be recorded for the X, Y, and Z orthogonal components, plus the equivalent vector sum.

A.3.3 In buildings with a large door opening, data will also be taken with the door open at the frequency where the vertical dimension of the opening is $\lambda/2$, and at 7 MHz, 400 MHz, and 4 GHz.

Again, we emphasize that the test plan may be modified for each test site by the engineers in charge to conform to any constraints imposed by time or the physical layout of the structure. Although the test plan recommends that measurements be grouped in four locations (fig. A.1), the engineers in charge may decide that three (or in some cases, two) groups are sufficient to determine the shielding effectiveness of the buildings.

A.4 Data Presentation

Attenuation measurements can be summarized in tables and also plotted. The table for each building, room, and transmitter location can list the frequencies of the test, the mean values of attenuation measured, and uncertainties of the measurement (one standard deviation) shown in parentheses. The mean value of attenuation is determined by averaging all grid point measurements in a particular building or room, for a particular frequency for each transmitter location:

$$\bar{X} = \frac{1}{N} \Sigma x_i$$

where $\bar{X}$ is the sample mean, N is the number of grid points measured, and x_i represents the individual attenuations at each measured grid point. The standard deviation is defined as the square root of the sample variance:

$$\sigma = \sqrt{s^2}$$

where

$$s^2 = \frac{1}{N-1}\Sigma(x_i-\bar{X})^2$$

and where σ is the standard deviation, s^2 is the sample variance, and x_i and $\bar{X}$ are already defined. The graphs show the mean attenuation at each measurement frequency, with the one-standard-deviation limits as error bars.

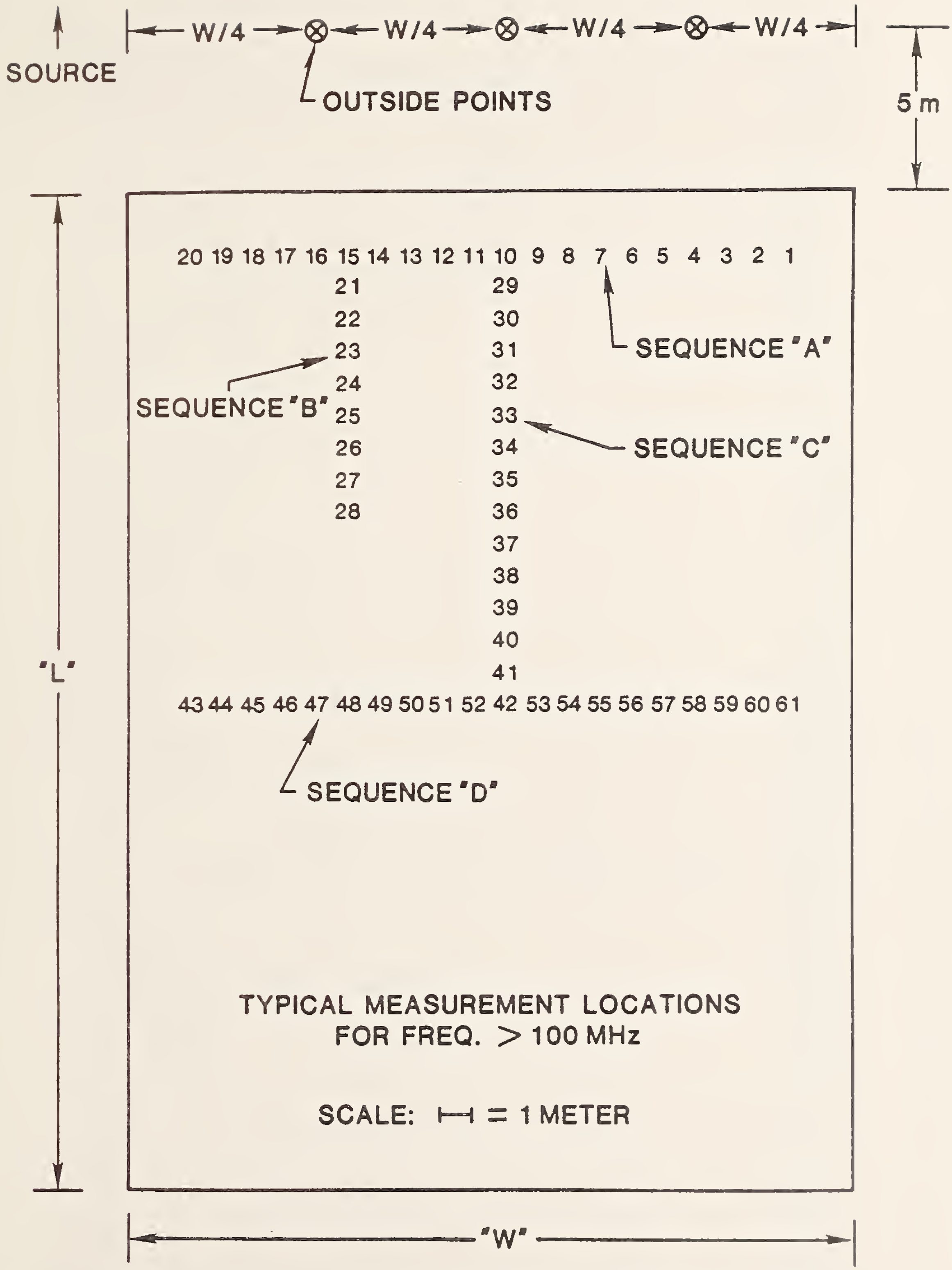

Figure A.1 Typical measurement locations for frequencies greater than 100 MHz

Appendix 9.2 Listing of Computer Program SMATDB

```
      PROGRAM SMATDB                                                    SMATDB     1
C**  INPUT MATERIAL ATTENUATION AND REFLECTION COEFFICIENT INTO         SMATDB     2
C**     ARRAYS AND THEN STORE DATA IN A PERMANENT FILE*                 SMATDB     3
**                                                                      SMATDB     4
************************************************************************COMM       1
***   COMMON FOR DATABASE OF MATERIAL PROPERTIES                     ***COMM       2
************************************************************************COMM       3
      INTEGER MMAX                                                      COMM       4
      PARAMETER (MMAX=100)                                              COMM       5
      COMMON /MATN/ MATTEN(MMAX,7), MRCOEF(MMAX,7), QA(MMAX), QR(MMAX), COMM       6
     $              MFREQ(MMAX,7), MERR, MTOT                           COMM       7
      COMMON /MATC/MAT(MMAX),MATDESC(MMAX)                              COMM       8
      INTEGER MTOT, MERR                                                COMM       9
      REAL MATTEN, MRCOEF, MFREQ, QA, QR                                COMM      10
      CHARACTER * 3  MAT                                                COMM      11
      CHARACTER * 70 MATDESC                                            COMM      12
************************************************************************COMM      13
************************************************************************COMM      14
      INTEGER R,C, COMMAND                                              SMATDB     6
      CHARACTER * 3 MATID                                               SMATDB     7
C*  INITIALIZE ARRAYS                                                   SMATDB     8
      DATA MAT / 100 * '   ' /                                          SMATDB     9
      DATA MATDESC / 100 * '   ' /                                      SMATDB    10
      DATA MFREQ / 700 * 0.0 /                                          SMATDB    11
      DATA MATTEN / 700 * 0.0 /                                         SMATDB    12
      DATA QA / 100 * 0.0 /                                             SMATDB    13
      DATA MRCOEF / 700 * 0.0 /                                         SMATDB    14
      DATA QR / 100 * 0.0 /                                             SMATDB    15
C*  ENTER COMMANDS                                                      SMATDB    16
      PRINT *, '(1) CREATE NEW DATABASE  (2) ADD TO EXISTING DATA ',    SMATDB    17
     Z       'BASE'                                                     SMATDB    18
      READ *, COMMAND                                                   SMATDB    19
      IF (COMMAND .EQ. 2) THEN                                          SMATDB    20
         CALL LMATTER                                                   SMATDB    21
         IF (MERR .NE. 0) CALL ERROR(5)                                 SMATDB    22
         ENDIF                                                          SMATDB    23
10    PRINT*,'(1) NEXT DATA ENTRY  (2) CHANGE  (3) DISPLAY  (4) ABORT', SMATDB    24
     $       '  (5) QUIT'                                               SMATDB    25
      READ *, COMMAND                                                   SMATDB    26
      PRINT *                                                           SMATDB    27
      IF (COMMAND .EQ. 1) THEN                                          SMATDB    28
         CALL NEXT                                                      SMATDB    29
      ELSE IF (COMMAND .EQ. 2 ) THEN                                    SMATDB    30
         CALL CHANGE                                                    SMATDB    31
      ELSE IF (COMMAND .EQ. 3 ) THEN                                    SMATDB    32
         CALL DISPLAY                                                   SMATDB    33
      ELSE IF (COMMAND .EQ. 4 ) THEN                                    SMATDB    34
        PRINT*                                                          SMATDB    35
        PRINT*,'PROGRAM ABORTED AT YOUR REQEST'                         SMATDB    36
        PRINT*                                                          SMATDB    37
        STOP                                                            SMATDB    38
      ELSE IF (COMMAND .EQ. 5 ) THEN                                    SMATDB    39
        CALL QUIT                                                       SMATDB    40
        STOP                                                            SMATDB    41
      ENDIF                                                             SMATDB    42
      GOTO 10                                                           SMATDB    43
      END                                                               SMATDB    44
```

```
--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  C         NONE               UNUSED/*S*       INTEGER
  COMMAND    157B                               INTEGER
  MAT          0B  /MATC/                       CHAR*3          100
  MATDESC     36B  /MATC/                       CHAR*70         100
  MATID     NONE               UNUSED/*S*       CHAR*3
  MATTEN       0B  /MATN/                       REAL            700
  MERR      4374B  /MATN/                       INTEGER
  MFREQ     3100B  /MATN/                       REAL            700
  MRCOEF    1274B  /MATN/                       REAL            700
  MTOT      4375B  /MATN/                       INTEGER
  QA        2570B  /MATN/                       REAL            100
  QR        2734B  /MATN/                       REAL            100
  R         NONE               UNUSED/*S*       INTEGER


--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE------------------------VALUE

  MMAX     INTEGER                      100


--PROCEDURES--(LO=A)
 -NAME------TYPE--------ARGS------CLASS-----      -NAME------TYPE--------ARGS------CLASS-----

  CHANGE                  0      SUBROUTINE        LMATTER                  0      SUBROUTINE
  DISPLAY                 0      SUBROUTINE        NEXT                     0      SUBROUTINE
  ERROR                   1      SUBROUTINE        QUIT                     0      SUBROUTINE


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

     10     24B                    37


--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  SMATDB      5B     0


--STATISTICS--

  PROGRAM-UNIT LENGTH            160B =   112
  CM LABELLED COMMON LENGTH     5730B =  3032
  CM STORAGE USED              61000B = 25088
  COMPILE TIME                 0.081 SECONDS
```

```
                                                                          SMATDB      45
      SUBROUTINE NEXT                                                     SMATDB      46
**************************************************************************COMM         1
***   COMMON FOR DATABASE OF MATERIAL PROPERTIES                       ***COMM         2
**************************************************************************COMM         3
      INTEGER MMAX                                                        COMM         4
      PARAMETER (MMAX=100)                                                COMM         5
      COMMON /MATN/ MATTEN(MMAX,7), MRCOEF(MMAX,7), QA(MMAX), QR(MMAX),  COMM         6
     $                MFREQ(MMAX,7), MERR, MTOT                           COMM         7
      COMMON /MATC/MAT(MMAX),MATDESC(MMAX)                                COMM         8
      INTEGER MTOT, MERR                                                  COMM         9
      REAL MATTEN, MRCOEF, MFREQ, QA, QR                                  COMM        10
      CHARACTER * 3  MAT                                                  COMM        11
      CHARACTER * 70 MATDESC                                              COMM        12
**************************************************************************COMM        13
**************************************************************************COMM        14
      INTEGER R,C, VAL, INDEX                                             SMATDB      48
      CHARACTER * 3 MATID                                                 SMATDB      49
      LOGICAL ENTERED                                                     SMATDB      50
10    PRINT *, 'MATERIAL I.D.?  (E.G.  ''M05'' OR ''M12'')'               SMATDB      51
      READ *, MATID                                                       SMATDB      52
      IF (MATID(1:1) .NE. 'M') THEN                                       SMATDB      53
         PRINT *, 'FIRST CHARACTER MUST BE AN M.   TRY AGAIN'             SMATDB      54
         GOTO 10                                                          SMATDB      55
         ENDIF                                                            SMATDB      56
C* CHECK IF THIS MATERIAL IS ALREADY ENTERED                               SMATDB      57
      ENTERED = .FALSE.                                                   SMATDB      58
      DO 20 R=1,MMAX                                                      SMATDB      59
      IF (MAT(R) .EQ. MATID) THEN                                         SMATDB      60
         ENTERED = .TRUE.                                                 SMATDB      61
         INDEX  = R                                                       SMATDB      62
         ENDIF                                                            SMATDB      63
20    CONTINUE                                                            SMATDB      64
C* ENTER NEW DATA IF MATERIAL NOT ALREADY ENTERED                          SMATDB      65
      IF (ENTERED) THEN                                                   SMATDB      66
         PRINT *, 'MATERIAL ',MATID,' ALREADY ENTERED'                    SMATDB      67
      ELSE                                                                SMATDB      68
         INDEX  = VAL ( MATID(2:3) )                                      SMATDB      69
      PRINT *,'INDEX:',INDEX                                              SMATDB      70
         MAT (INDEX) = MATID                                              SMATDB      71
         PRINT *, 'ENTER ONE LINE DESCRIPTION OF MATERIAL'                SMATDB      72
         READ *, MATDESC (INDEX)                                          SMATDB      73
         PRINT *, 'ENTER 7 ATTENUATION VALUES FROM LOW TO HIGH FREQ'      SMATDB      74
         READ *, (MATTEN(INDEX,C), C=1,7)                                 SMATDB      75
         PRINT *, 'ENTER ATTENUATION QUALITY PERCENT'                     SMATDB      76
         READ *, QA (INDEX)                                               SMATDB      77
         PRINT *, 'ENTER 7 REFLECTION COEFFS FROM LOW TO HIGH FREQ'       SMATDB      78
         READ *, (MRCOEF(INDEX,C), C=1,7)                                 SMATDB      79
         PRINT *, 'ENTER REFLECTION COEFICIENT QUALITY PERCENT'           SMATDB      80
         READ *, QR (INDEX)                                               SMATDB      81
         PRINT *                                                          SMATDB      82
         ENDIF                                                            SMATDB      83
      RETURN                                                              SMATDB      84
      END                                                                 SMATDB      85
```

```
--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

 C          357B                             INTEGER
 ENTERED    362B                             LOGICAL
 INDEX      360B                             INTEGER
 MAT          0B   /MATC/                    CHAR*3          100
 MATDESC     36B   /MATC/                    CHAR*70         100
```

```
 MATID     361B                                CHAR*3
 MATTEN      0B  /MATN/                        REAL            700
 MERR     4374B  /MATN/                        INTEGER
 MFREQ    3100B  /MATN/                        REAL            700
 MRCOEF   1274B  /MATN/                        REAL            700
 MTOT     4375B  /MATN/                        INTEGER
 QA       2570B  /MATN/                        REAL            100
 QR       2734B  /MATN/                        REAL            100
 R         356B                                INTEGER


--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE------------------------VALUE

 MMAX    INTEGER                        100


--PROCEDURES--(LO=A)
 -NAME------TYPE--------ARGS------CLASS-----

 VAL       INTEGER        1      FUNCTION


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

    10      5B                    20
    20  INACTIVE   DO-TERM        33


--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

 NEXT        4B     0


--STATISTICS--

 PROGRAM-UNIT LENGTH             366B =  246
 CM LABELLED COMMON LENGTH      5730B =  3032
 CM STORAGE USED               61000B =  25088
 COMPILE TIME                  0.117 SECONDS
```

```
                                                                       SMATDB    86
                                                                       SMATDB    87
      SUBROUTINE DISPLAY                                               SMATDB    88
************************************************************************COMM      1
***   COMMON FOR DATABASE OF MATERIAL PROPERTIES                     ***COMM      2
************************************************************************COMM      3
      INTEGER MMAX                                                      COMM      4
      PARAMETER (MMAX=100)                                              COMM      5
      COMMON /MATN/ MATTEN(MMAX,7), MRCOEF(MMAX,7), QA(MMAX), QR(MMAX), COMM      6
     $              MFREQ(MMAX,7), MERR, MTOT                           COMM      7
      COMMON /MATC/MAT(MMAX),MATDESC(MMAX)                              COMM      8
      INTEGER MTOT, MERR                                                COMM      9
      REAL MATTEN, MRCOEF, MFREQ, QA, QR                                COMM     10
      CHARACTER * 3  MAT                                                COMM     11
      CHARACTER * 70 MATDESC                                            COMM     12
************************************************************************COMM     13
************************************************************************COMM     14
      INTEGER R,C, COMMAND                                              SMATDB    90
      CHARACTER * 3 MATID                                               SMATDB    91
      LOGICAL FOUND                                                     SMATDB    92
      PRINT *, '(1) ALL MATERIALS  OR  (2) ONE MATERIAL'                SMATDB    93
      READ *, COMMAND                                                   SMATDB    94
      PRINT *                                                           SMATDB    95
      IF (COMMAND .EQ. 1) THEN                                          SMATDB    96
         PRINT *                                                        SMATDB    97
         DO 10 R = 1,MMAX                                               SMATDB    98
            MATID = MAT(R)                                              SMATDB    99
            IF  (MATID(1:1).EQ.'M' ) THEN                               SMATDB   100
                PRINT * , MAT(R)                                        SMATDB   101
                PRINT * , MATDESC (R)                                   SMATDB   102
                PRINT *, 'FREQUENCY: ' ,(MFREQ(R,C),C=1,7)              SMATDB   103
                PRINT * , 'ATTENUATION: ' ,(MATTEN(R,C), C=1,7)         SMATDB   104
                PRINT *,'ATTENUATION QUALITY PERCENT: ',QA(R)           SMATDB   105
                PRINT * , 'REFLECTION: ' , (MRCOEF(R,C), C=1,7)         SMATDB   106
                PRINT *,'REFLECTION COEF QUALITY PERCENT: ',QR(R)       SMATDB   107
                PRINT *                                                 SMATDB   108
                ENDIF                                                   SMATDB   109
 10      CONTINUE                                                       SMATDB   110
      ELSEIF (COMMAND .EQ. 2 ) THEN                                     SMATDB   111
         PRINT *, 'SPECIFY ID OF MATERIAL TO BE PRINTED (E.Q. M05)'     SMATDB   112
         READ *, MATID                                                  SMATDB   113
         FOUND = .FALSE.                                                SMATDB   114
         DO 20 R = 1,MMAX                                               SMATDB   115
            IF (MAT(R) .EQ. MATID) THEN                                 SMATDB   116
               PRINT *, MAT(R)                                          SMATDB   117
               PRINT *, MATDESC(R)                                      SMATDB   118
               PRINT *, 'FREQUENCY: ' ,(MFREQ(R,C),C=1,7)               SMATDB   119
               PRINT *, 'ATTENUATION: ',(MATTEN(R,C), C=1,7)            SMATDB   120
               PRINT *, 'ATTENUATION QUALITY PERCENT: ',QA(R)           SMATDB   121
               PRINT *, 'REFLECTION: ',(MRCOEF(R,C), C=1,7)             SMATDB   122
               PRINT *, 'REFLECTION QUALITY PERCENT: ',QR(R)            SMATDB   123
               FOUND = .TRUE.                                           SMATDB   124
               ENDIF                                                    SMATDB   125
 20      CONTINUE                                                       SMATDB   126
         ENDIF                                                          SMATDB   127
            IF (.NOT. FOUND) THEN                                       SMATDB   128
               PRINT *, 'MATERIAL ', MATID, ' NOT FOUND'                SMATDB   129
               ENDIF                                                    SMATDB   130
         PRINT *                                                        SMATDB   131
      RETURN                                                            SMATDB   132
      END                                                               SMATDB   133
```

```
SUBROUTINE DISPLAY  74/175  OPT=0

--VARIABLE MAP--(LO=A)
-NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

 C          511B                            INTEGER
 COMMAND    512B                            INTEGER
 FOUND      514B                            LOGICAL
 MAT          0B  /MATC/                    CHAR*3         100
 MATDESC     36B  /MATC/                    CHAR*70        100
 MATID      513B                            CHAR*3
 MATTEN       0B  /MATN/                    REAL           700
 MERR      4374B  /MATN/                    INTEGER
 MFREQ     3100B  /MATN/                    REAL           700
 MRCOEF    1274B  /MATN/                    REAL           700
 MTOT      4375B  /MATN/                    INTEGER
 QA        2570B  /MATN/                    REAL           100
 QR        2734B  /MATN/                    REAL           100
 R          510B                            INTEGER

--SYMBOLIC CONSTANTS--(LO=A)
-NAME----TYPE-----------------------VALUE

 MMAX    INTEGER                      100

--STATEMENT LABELS--(LO=A)
-LABEL-ADDRESS-----PROPERTIES----DEF

    10  INACTIVE   DO-TERM        38
    20  INACTIVE   DO-TERM        54

--ENTRY POINTS--(LO=A)
-NAME---ADDRESS--ARGS---

 DISPLAY     4B     0

--STATISTICS--

 PROGRAM-UNIT LENGTH             525B =  341
 CM LABELLED COMMON LENGTH      5730B =  3032
 CM STORAGE USED               61000B =  25088
 COMPILE TIME                  0.172 SECONDS
```

```
                                                                                          SMATDB    134
                                                                                          SMATDB    135
      INTEGER FUNCTION VAL(STRING)                                                        SMATDB    136
C** RETURNS THE INTEGER VALUE OF A STRING.                                                SMATDB    137
      INTEGER NUMBER, X,L,EXP,DIGIT,GETLEN                                                SMATDB    138
      CHARACTER * (*) STRING                                                              SMATDB    139
      L = GETLEN(STRING)                                                                  SMATDB    140
      NUMBER = 0                                                                          SMATDB    141
      DO 10 X = L,1,-1                                                                    SMATDB    142
      EXP = L - X                                                                         SMATDB    143
      DIGIT = ICHAR(STRING(X:X)) - 16                                                     SMATDB    144
      NUMBER = NUMBER + DIGIT*10**EXP                                                     SMATDB    145
10    CONTINUE                                                                            SMATDB    146
      VAL = NUMBER                                                                        SMATDB    147
      RETURN                                                                              SMATDB    148
      END                                                                                 SMATDB    149
```

```
--VARIABLE MAP--(LO=A)
-NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

 DIGIT      76B                             INTEGER
 EXP        75B                             INTEGER
 L          74B                             INTEGER
 NUMBER     72B                             INTEGER
 STRING      1   DUMMY-ARG                  CHAR*(*)
 VAL        71B                             INTEGER
 X          73B                             INTEGER


--PROCEDURES--(LO=A)
-NAME------TYPE--------ARGS------CLASS-----

 GETLEN    INTEGER        1      FUNCTION
 ICHAR     INTEGER        1      INTRINSIC


--STATEMENT LABELS--(LO=A)
-LABEL-ADDRESS-----PROPERTIES----DEF

    10  INACTIVE   DO-TERM        13


--ENTRY POINTS--(LO=A)
-NAME---ADDRESS--ARGS---

 VAL         6B     1


--STATISTICS--

 PROGRAM-UNIT LENGTH          102B =  66
 CM STORAGE USED            61000B =  25088
 COMPILE TIME               0.041 SECONDS
```

```


      INTEGER FUNCTION GETLEN (STRING)
C
C DETERMINE LENGTH OF STRING EXCLUDING ANY BLANK PADDING
C
C
C ARGUMENT DEFINITIONS --
C   INPUT ARGUMENTS
C     STRING - STRING WHOSE LENGTH IS TO BE DETERMINED
C
      CHARACTER * (*) STRING
C
C FUNCTION PARAMETERS
      CHARACTER * 1 BLANK
      PARAMETER (BLANK = ' ')
C
C LOCAL VARIABLES
      INTEGER NEXT
C
C START WITH THE LAST CHARACTER AND FIND THE FIRST NON-BLANK
      DO 10 NEXT = LEN(STRING),1,-1
         IF (STRING(NEXT : NEXT) .NE. BLANK) THEN
            GETLEN = NEXT
            RETURN
         ENDIF
   10 CONTINUE
C
C ALL CHARACTERS ARE BLANKS
      GETLEN = 0
C
      RETURN
      END
```

```
--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  GETLEN     63B                             INTEGER
  NEXT       64B                             INTEGER
  STRING      1   DUMMY-ARG                  CHAR*(*)


--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE-----------------------VALUE

  BLANK   CHAR*1                        ' '


--PROCEDURES--(LO=A)
 -NAME------TYPE--------ARGS------CLASS-----

  LEN       INTEGER       1       INTRINSIC


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

    10  INACTIVE   DO-TERM        27
```



```
--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  GETLEN      6B      1


--STATISTICS--

  PROGRAM-UNIT LENGTH              70B =  56
  CM STORAGE USED               61000B =  25088
  COMPILE TIME                  0.038 SECONDS
```

```
                                                                                SMATDB   183
                                                                                SMATDB   184
      SUBROUTINE QUIT                                                           SMATDB   185
*****************************************************************************COMM      1
***   COMMON FOR DATABASE OF MATERIAL PROPERTIES                             ***COMM      2
*****************************************************************************COMM      3
      INTEGER MMAX                                                              COMM      4
      PARAMETER (MMAX=100)                                                      COMM      5
      COMMON /MATN/ MATTEN(MMAX,7), MRCOEF(MMAX,7), QA(MMAX), QR(MMAX),         COMM      6
     $               MFREQ(MMAX,7), MERR, MTOT                                  COMM      7
      COMMON /MATC/MAT(MMAX),MATDESC(MMAX)                                      COMM      8
      INTEGER MTOT, MERR                                                        COMM      9
      REAL MATTEN, MRCOEF, MFREQ, QA, QR                                        COMM     10
      CHARACTER * 3  MAT                                                        COMM     11
      CHARACTER * 70 MATDESC                                                    COMM     12
*****************************************************************************COMM     13
*****************************************************************************COMM     14
      INTEGER R,C                                                               SMATDB   187
      CHARACTER * 3 MATID                                                       SMATDB   188
      LOGICAL FOUND                                                             SMATDB   189
      OPEN (UNIT =6,FILE='MATTER',FORM='FORMATTED',                             SMATDB   190
     Z     ACCESS='SEQUENTIAL', STATUS='NEW')                                   SMATDB   191
      REWIND (6)                                                                SMATDB   192
      DO 10 R=1,MMAX                                                            SMATDB   193
         MATID = MAT(R)                                                         SMATDB   194
         IF (MATID(1:1) .EQ. 'M' ) THEN                                         SMATDB   195
            WRITE (6,100) MAT(R)                                                SMATDB   196
            WRITE (6,200) MATDESC (R)                                           SMATDB   197
            WRITE (6,400) 1E+4, 1E+5 ,1E+6, 1E+7, 1E+8, 1E+9, 1E+10             SMATDB   198
            WRITE (6,400) (MATTEN(R,C),C=1,7)                                   SMATDB   199
            WRITE (6,400) QA(R)                                                 SMATDB   200
            WRITE (6,400) (MRCOEF(R,C),C=1,7)                                   SMATDB   201
            WRITE (6,400) QR(R)                                                 SMATDB   202
            ENDIF                                                               SMATDB   203
10    CONTINUE                                                                  SMATDB   204
      ENDFILE (6)                                                               SMATDB   205
      CALL PF ('REPLACE',0,'MATTER')                                            SMATDB   206
      CLOSE (6, STATUS = 'DELETE')                                              SMATDB   207
100   FORMAT (A3)                                                               SMATDB   208
200   FORMAT (A70)                                                              SMATDB   209
400   FORMAT (7(1X, E9.3))                                                      SMATDB   210
      RETURN                                                                    SMATDB   211
      END                                                                       SMATDB   212
```

```
--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

 C          270B                             INTEGER
 FOUND      NONE             UNUSED/*S*      LOGICAL
 MAT          0B  /MATC/                     CHAR*3        100
 MATDESC     36B  /MATC/                     CHAR*70       100
 MATID      271B                             CHAR*3
 MATTEN       0B  /MATN/                     REAL          700
 MERR      4374B  /MATN/                     INTEGER
 MFREQ     3100B  /MATN/                     REAL          700
 MRCOEF    1274B  /MATN/                     REAL          700
 MTOT      4375B  /MATN/                     INTEGER
 QA        2570B  /MATN/                     REAL          100
 QR        2734B  /MATN/                     REAL          100
 R          267B                             INTEGER
```

```
--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE------------------------VALUE

  MMAX    INTEGER                        100


--PROCEDURES--(LO=A)
 -NAME------TYPE--------ARGS------CLASS-----

  PF                       3      SUBROUTINE


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

     10  INACTIVE   DO-TERM        35
    100     164B    FORMAT         39
    200     166B    FORMAT         40
    400     170B    FORMAT         41


--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  QUIT        5B     0


--I/O UNITS--(LO=A)
 -NAME--- PROPERTIES-------------

  TAPE6   AUX/FMT/SEQ


--STATISTICS--

  PROGRAM-UNIT LENGTH            277B =  191
  CM LABELLED COMMON LENGTH     5730B =  3032
  CM STORAGE USED              61000B =  25088
  COMPILE TIME                 0.101 SECONDS
```

```
                                                                        SMATDB     213
                                                                        SMATDB     214
                                                                        SMATDB     215
                                                                        SMATDB     216
      SUBROUTINE CHANGE                                                 SMATDB     217
C***********************************************************************COMM         1
C***   COMMON FOR DATABASE OF MATERIAL PROPERTIES                    ***COMM         2
C***********************************************************************COMM         3
      INTEGER MMAX                                                      COMM         4
      PARAMETER (MMAX=100)                                              COMM         5
      COMMON /MATN/ MATTEN(MMAX,7), MRCOEF(MMAX,7), QA(MMAX), QR(MMAX), COMM         6
     $              MFREQ(MMAX,7), MERR, MTOT                           COMM         7
      COMMON /MATC/MAT(MMAX),MATDESC(MMAX)                              COMM         8
      INTEGER MTOT, MERR                                                COMM         9
      REAL MATTEN, MRCOEF, MFREQ, QA, QR                                COMM        10
      CHARACTER * 3  MAT                                                COMM        11
      CHARACTER * 70 MATDESC                                            COMM        12
C***********************************************************************COMM        13
C***********************************************************************COMM        14
      INTEGER R,C,COMMAND, VAL, INDEX                                   SMATDB     219
      CHARACTER * 3 MATID                                               SMATDB     220
      LOGICAL FOUND                                                     SMATDB     221
      PRINT *, 'ENTER MATERIAL I.D. OF GROUP TO BE CHANGED'             SMATDB     222
         READ *, MATID                                                  SMATDB     223
         FOUND = .FALSE.                                                SMATDB     224
         DO 20 R = 1,MMAX                                               SMATDB     225
            IF (MAT(R) .EQ. MATID) THEN                                 SMATDB     226
               PRINT *                                                  SMATDB     227
               PRINT *, 'LINE 1:    MATERIAL ID '                       SMATDB     228
               PRINT *, MAT (R)                                         SMATDB     229
               PRINT *, 'LINE 2:     DESCRIPTION'                       SMATDB     230
               PRINT *, MATDESC (R)                                     SMATDB     231
               PRINT *, 'LINE 3:      FREQUENCIES'                      SMATDB     232
               PRINT *, (MFREQ (R,C), C=1,7)                            SMATDB     233
               PRINT *, 'LINE 4:      ATTENUATIONS'                     SMATDB     234
               PRINT *, (MATTEN (R,C), C=1,7)                           SMATDB     235
               PRINT *, 'LINE 5:      ATTENUATION QUALITY PERCENT'      SMATDB     236
               PRINT *, QA (R)                                          SMATDB     237
               PRINT *, 'LINE 6:     REFLECTION COEFFICIENTS'           SMATDB     238
               PRINT *, (MRCOEF (R,C), C=1,7)                           SMATDB     239
               PRINT *, 'LINE 7:  REFLECTION QUALITY PERCENT'           SMATDB     240
               PRINT *, QR (R)                                          SMATDB     241
               FOUND = .TRUE.                                           SMATDB     242
               INDEX = R                                                SMATDB     243
               ENDIF                                                    SMATDB     244
 20      CONTINUE                                                       SMATDB     245
            IF (.NOT. FOUND) THEN                                       SMATDB     246
               PRINT *, 'MATERIAL ', MATID, ' NOT FOUND'                SMATDB     247
               RETURN                                                   SMATDB     248
               ENDIF                                                    SMATDB     249
 30   PRINT *                                                           SMATDB     250
      PRINT *, 'ENTER NUMBER OF LINE TO BE CHANGED',                    SMATDB     251
     Z       '      (99 TO END CHANGES)'                                SMATDB     252
      READ *, COMMAND                                                   SMATDB     253
      IF (COMMAND .EQ. 1) THEN                                          SMATDB     254
         PRINT *, 'ENTER NEW I.D.'                                      SMATDB     255
         MAT (INDEX) = '   '                                            SMATDB     256
         READ *, MATID                                                  SMATDB     257
         R = VAL ( MATID(2:3) )                                         SMATDB     258
         MAT (R) = MATID                                                SMATDB     259
         MATDESC (R) = MATDESC (INDEX)                                  SMATDB     260
         MFREQ (R,1) = MFREQ (INDEX,1)                                  SMATDB     261
         MFREQ (R,2) = MFREQ (INDEX,2)                                  SMATDB     262
         MFREQ (R,3) = MFREQ (INDEX,3)                                  SMATDB     263
```

```
          MFREQ (R,4) = MFREQ (INDEX,4)                                  SMATDB   264
          MFREQ (R,5) = MFREQ (INDEX,5)                                  SMATDB   265
          MFREQ (R,6) = MFREQ (INDEX,6)                                  SMATDB   266
          MFREQ (R,7) = MFREQ (INDEX,7)                                  SMATDB   267
          MATTEN (R,1) = MATTEN (INDEX,1)                                SMATDB   268
          MATTEN (R,2) = MATTEN (INDEX,2)                                SMATDB   269
          MATTEN (R,3) = MATTEN (INDEX,3)                                SMATDB   270
          MATTEN (R,4) = MATTEN (INDEX,4)                                SMATDB   271
          MATTEN (R,5) = MATTEN (INDEX,5)                                SMATDB   272
          MATTEN (R,6) = MATTEN (INDEX,6)                                SMATDB   273
          MATTEN (R,7) = MATTEN (INDEX,7)                                SMATDB   274
          QA (R) = QA (INDEX)                                            SMATDB   275
          MRCOEF (R,1) = MRCOEF (INDEX,1)                                SMATDB   276
          MRCOEF (R,2) = MRCOEF (INDEX,2)                                SMATDB   277
          MRCOEF (R,3) = MRCOEF (INDEX,3)                                SMATDB   278
          MRCOEF (R,4) = MRCOEF (INDEX,4)                                SMATDB   279
          MRCOEF (R,5) = MRCOEF (INDEX,5)                                SMATDB   280
          MRCOEF (R,6) = MRCOEF (INDEX,6)                                SMATDB   281
          MRCOEF (R,7) = MRCOEF (INDEX,7)                                SMATDB   282
          QR (R) = QR (INDEX)                                            SMATDB   283
          INDEX = R                                                      SMATDB   284
        ELSE IF ( COMMAND .EQ. 2 ) THEN                                  SMATDB   285
          PRINT *, 'ENTER NEW ONE LINE DESCRIPTION OF MATERIAL'          SMATDB   286
          READ *, MATDESC (INDEX)                                        SMATDB   287
        ELSE IF ( COMMAND .EQ. 3 ) THEN                                  SMATDB   288
          PRINT *, 'ENTER NEW SET OF 7 FREQUENCIES'                      SMATDB   289
          READ *, (MFREQ (INDEX,C), C=1,7)                               SMATDB   290
        ELSE IF ( COMMAND .EQ. 4 ) THEN                                  SMATDB   291
          PRINT *, 'ENTER NEW SET OF 7 ATTENUATIONS'                     SMATDB   292
          READ *, (MATTEN (INDEX,C), C=1,7)                              SMATDB   293
        ELSE IF ( COMMAND .EQ. 5 ) THEN                                  SMATDB   294
          PRINT *, 'ENTER NEW ATTENUATION QUALITY PERCENT'               SMATDB   295
          READ *, QA (INDEX)                                             SMATDB   296
        ELSE IF ( COMMAND .EQ. 6 ) THEN                                  SMATDB   297
          PRINT *, 'ENTER NEW SET OF 7 REFLECTION COEFFICIENTS'          SMATDB   298
          READ *, (MRCOEF (INDEX,C), C=1,7)                              SMATDB   299
        ELSE IF ( COMMAND .EQ. 7 ) THEN                                  SMATDB   300
          PRINT *, 'ENTER NEW REFLECTION QUALITY PERCENT'                SMATDB   301
          READ *, QR (INDEX)                                             SMATDB   302
        ELSE IF ( COMMAND .EQ. 99 ) THEN                                 SMATDB   303
          GOTO 40                                                        SMATDB   304
          ENDIF                                                          SMATDB   305
        GOTO 30                                                          SMATDB   306
C                                                                        SMATDB   307
 40     PRINT *                                                          SMATDB   308
        PRINT *, MAT (INDEX)                                             SMATDB   309
        PRINT *, MATDESC (INDEX)                                         SMATDB   310
        PRINT *, (MFREQ (INDEX,C), C=1,7)                                SMATDB   311
        PRINT *, (MATTEN (INDEX,C), C=1,7)                               SMATDB   312
        PRINT *, QA (INDEX)                                              SMATDB   313
        PRINT *, (MRCOEF (INDEX,C), C=1,7)                               SMATDB   314
        PRINT *, QR (INDEX)                                              SMATDB   315
        PRINT *                                                          SMATDB   316
        RETURN                                                           SMATDB   317
        END                                                              SMATDB   318
```

```
SUBROUTINE CHANGE    74/175  OPT=0

--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  C          1137B                                INTEGER
  COMMAND    1140B                                INTEGER
  FOUND      1143B                                LOGICAL
  INDEX      1141B                                INTEGER
  MAT          0B   /MATC/                        CHAR*3         100
  MATDESC     36B   /MATC/                        CHAR*70        100
  MATID      1142B                                CHAR*3
  MATTEN       0B   /MATN/                        REAL           700
  MERR       4374B  /MATN/                        INTEGER
  MFREQ      3100B  /MATN/                        REAL           700
  MRCOEF     1274B  /MATN/                        REAL           700
  MTOT       4375B  /MATN/                        INTEGER
  QA         2570B  /MATN/                        REAL           100
  QR         2734B  /MATN/                        REAL           100
  R          1136B                                INTEGER


--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE------------------------VALUE

  MMAX    INTEGER                       100


--PROCEDURES--(LO=A)
 -NAME------TYPE--------ARGS------CLASS-----

  VAL       INTEGER        1      FUNCTION


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

    20  INACTIVE   DO-TERM        46
    30     204B                   51
    40     477B                  109


--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  CHANGE      5B     0


--STATISTICS--

  PROGRAM-UNIT LENGTH            1160B =   624
  CM LABELLED COMMON LENGTH      5730B =  3032
  CM STORAGE USED               63000B = 26112
  COMPILE TIME                  0.318 SECONDS
```

```
      SUBROUTINE LMATTER                                                LMATTER    1
*!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!LMATTER    2
*!!!                                                                 !!!LMATTER    3
*!!!  THIS SUBROUTINE LOADS THE MATERIAL DATABASE INTO ARRAYS FOR    !!!LMATTER    4
*!!!  FURTHER PROGRAM USE.                                           !!!LMATTER    5
*!!!                                                                 !!!LMATTER    6
*!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!LMATTER    7
************************************************************************LMATTER    8
************************************************************************COMM       1
***   COMMON FOR DATABASE OF MATERIAL PROPERTIES                     ***COMM       2
************************************************************************COMM       3
      INTEGER MMAX                                                      COMM       4
      PARAMETER (MMAX=100)                                              COMM       5
      COMMON /MATN/ MATTEN(MMAX,7), MRCOEF(MMAX,7), QA(MMAX), QR(MMAX), COMM       6
     $              MFREQ(MMAX,7), MERR, MTOT                           COMM       7
      COMMON /MATC/MAT(MMAX),MATDESC(MMAX)                              COMM       8
      INTEGER MTOT, MERR                                                COMM       9
      REAL MATTEN, MRCOEF, MFREQ, QA, QR                                COMM      10
      CHARACTER * 3  MAT                                                COMM      11
      CHARACTER * 70 MATDESC                                            COMM      12
************************************************************************COMM      13
************************************************************************COMM      14
**************************************************                      LMATTER   10
*   DECLARATION OF VARIABLES                                            LMATTER   11
**************************************************                      LMATTER   12
      INTEGER R, C, VAL                                                 LMATTER   13
      CHARACTER * 3 MATID                                               LMATTER   14
**************************************************                      LMATTER   15
*  GET FILE                                                             LMATTER   16
**************************************************                      LMATTER   17
      MERR = 0                                                          LMATTER   18
      CALL PF ('GET',0,'MATTER','RC',MERR)                              LMATTER   19
**************************************************                      LMATTER   20
*  FILE ERROR CHECK                                                     LMATTER   21
**************************************************                      LMATTER   22
      IF ( MERR .EQ. 0 ) THEN                                           LMATTER   23
999     CONTINUE                                                        LMATTER   24
      ELSE IF ( MERR .EQ. 2 ) THEN                                      LMATTER   25
        CALL WARNING (3)                                                LMATTER   26
        RETURN                                                          LMATTER   27
      ELSE                                                              LMATTER   28
        CALL WARNING (4)                                                LMATTER   29
        RETURN                                                          LMATTER   30
      END IF                                                            LMATTER   31
**************************************************                      LMATTER   32
*   OPEN FILE                                                           LMATTER   33
**************************************************                      LMATTER   34
      OPEN (UNIT = 3, FILE='MATTER',FORM='FORMATTED',                   LMATTER   35
     $      STATUS = 'OLD', ACCESS = 'SEQUENTIAL')                      LMATTER   36
      REWIND (3)                                                        LMATTER   37
**************************************************                      LMATTER   38
*  INITIALIZE ARRAYS                                                    LMATTER   39
**************************************************                      LMATTER   40
      DATA MAT / 100 * '   ' /                                          LMATTER   41
      DATA MATDESC / 100 * '   ' /                                      LMATTER   42
      DATA MFREQ / 700 * 0.0 /                                          LMATTER   43
      DATA MATTEN / 700 * 0.0 /                                         LMATTER   44
      DATA QA / 100 * 0.0 /                                             LMATTER   45
      DATA MRCOEF / 700 * 0.0 /                                         LMATTER   46
      DATA QR / 100 * 0.0 /                                             LMATTER   47
**************************************************                      LMATTER   48
*  READ IN THE MATERIAL FILE                                            LMATTER   49
**************************************************                      LMATTER   50
10    READ (3,1000,END=20) MATID                                        LMATTER   51
```

```
     65        R = VAL(MATID(2:3))                                              LMATTER      52
     66        MAT (R) = MATID                                                  LMATTER      53
     67        READ (3,2000,END=20) MATDESC (R)                                 LMATTER      54
     68        READ (3,4000,END=20) (MFREQ(R,C),C=1,7)                          LMATTER      55
     69        READ (3,4000,END=20) (MATTEN(R,C),C=1,7)                         LMATTER      56
     70        READ (3,4000,END=20) QA (R)                                      LMATTER      57
     71        READ (3,4000,END=20) (MRCOEF(R,C),C=1,7)                         LMATTER      58
     72        READ (3,4000,END=20) QR (R)                                      LMATTER      59
     73        GOTO 10                                                          LMATTER      60
     74 20     CONTINUE                                                         LMATTER      61
     75 1000   FORMAT (A3)                                                      LMATTER      62
     76 2000   FORMAT (A70)                                                     LMATTER      63
     77 4000   FORMAT (7(1X,E9.3))                                              LMATTER      64
     78 ************************************************                        LMATTER      65
     79 *  CLOSE FILE                                                           LMATTER      66
     80 ************************************************                        LMATTER      67
     81        CLOSE (3,STATUS = 'DELETE')                                      LMATTER      68
     82        RETURN                                                           LMATTER      69
     83        END                                                              LMATTER      70
```

```
--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  C          327B                                INTEGER
  MAT          0B  /MATC/                        CHAR*3        100
  MATDESC     36B  /MATC/                        CHAR*70       100
  MATID      330B                                CHAR*3
  MATTEN       0B  /MATN/                        REAL          700
  MERR      4374B  /MATN/                        INTEGER
  MFREQ     3100B  /MATN/                        REAL          700
  MRCOEF    1274B  /MATN/                        REAL          700
  MTOT      4375B  /MATN/                        INTEGER
  QA        2570B  /MATN/                        REAL          100
  QR        2734B  /MATN/                        REAL          100
  R          326B                                INTEGER
```

```
--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE-----------------------VALUE

  MMAX    INTEGER                      100
```

```
--PROCEDURES--(LO=A)
 -NAME------TYPE--------ARGS------CLASS-----

  PF                     5       SUBROUTINE
  VAL       INTEGER      1       FUNCTION
  WARNING                1       SUBROUTINE
```

```
--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF       -LABEL-ADDRESS-----PROPERTIES----DEF

    10     36B                     64         1000    202B     FORMAT          75
    20    160B                     74         2000    204B     FORMAT          76
   999 *NO REFS*                   37         4000    206B     FORMAT          77
```

```
--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  LMATTER     5B     0


--I/O UNITS--(LO=A)
 -NAME--- PROPERTIES-------------

  TAPE3   AUX/FMT/SEQ


--STATISTICS--

  PROGRAM-UNIT LENGTH             336B =  222
  CM LABELLED COMMON LENGTH      5730B =  3032
  CM STORAGE USED               61000B =  25088
  COMPILE TIME                  0.127 SECONDS
```

```
FTN 5.1+552          83/12/24. 09.48.06 PAGE     18
SUBROUTINE WARNING  74/175  OPT=0

      1        SUBROUTINE WARNING(ERR)                                           WARNING      1
      2        INTEGER ERR, ERRM                                                 WARNING      2
      3        CHARACTER*45 MESSAGE(20)                                          WARNING      3
      4        DATA MESSAGE( 1)/'"HOLE" DATA FILE DOES NOT EXIST FOR THIS BLDG'/ WARNING      4
      5        DATA MESSAGE( 2)/'FILE HANDLING PROBLEM ON "HOLE" DATA FILE    '/ WARNING      5
      6        DATA MESSAGE( 3)/'"MATTER" FILE DOES NOT EXIST FOR THIS BLDG   '/ WARNING      6
      7        DATA MESSAGE( 4)/'FILE HANDLING PROBLEM ON "MATTER FILE        '/ WARNING      7
      8        DATA MESSAGE( 5)/'"TYPE" DATA FILE DOES NOT EXIST FOR THIS BLDG'/ WARNING      8
      9        DATA MESSAGE( 6)/'FILE HANDLING PROBLEM ON "TYPE" FILE         '/ WARNING      9
     10        DATA MESSAGE( 7)/'"WALL" DATA FILE DOES NOT EXIST FOR THIS BLDG'/ WARNING     10
     11        DATA MESSAGE( 8)/'FILE HANDLING PROBLEM ON "WALL" FILE         '/ WARNING     11
     12        DATA MESSAGE( 9)/'HEIGHT AND WIDTH OF ROOM MISSING             '/ WARNING     12
     13        DATA MESSAGE(10)/'LENGTH OF ROOM IS MISSING                    '/ WARNING     13
     14        DATA MESSAGE(11)/'FREQ FILE DOES NOT EXIST FOR THIS BLDG       '/ WARNING     14
     15        DATA MESSAGE(12)/'FILE HANDLING PROBLEM WITH FREQ FILE         '/ WARNING     15
     16        DATA MESSAGE(13)/'WARNING CODE IS OUT OF RANGE                 '/ WARNING     16
     17        DATA MESSAGE(14)/'WARNING CODE IS OUT OF RANGE                 '/ WARNING     17
     18        DATA MESSAGE(15)/'WARNING CODE IS OUT OF RANGE                 '/ WARNING     18
     19        DATA MESSAGE(16)/'WARNING CODE IS OUT OF RANGE                 '/ WARNING     19
     20        DATA MESSAGE(17)/'WARNING CODE IS OUT OF RANGE                 '/ WARNING     20
     21        DATA MESSAGE(18)/'WARNING CODE IS OUT OF RANGE                 '/ WARNING     21
     22        DATA MESSAGE(19)/'WARNING CODE IS OUT OF RANGE                 '/ WARNING     22
     23        DATA MESSAGE(20)/'WARNING CODE IS OUT OF RANGE                 '/ WARNING     23
     24        ERRM=12                                                           WARNING     24
     25        IERR = ERR                                                        WARNING     25
     26        IF(ERR.GT.ERRM) IERR=20                                           WARNING     26
     27        WRITE(6,20)                                                       WARNING     27
     28        WRITE(6,10) ERR,MESSAGE(IERR)                                     WARNING     28
     29        WRITE(6,20)                                                       WARNING     29
     30 10     FORMAT(' ***WARNING NUMBER = ',I5,' ***  ',A45)                   WARNING     30
     31 20     FORMAT('     ')                                                  WARNING     31
     32        RETURN                                                            WARNING     32
     33        END                                                               WARNING     33

--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

 ERR          1   DUMMY-ARG                   INTEGER
 ERRM        60B                              INTEGER
 IERR       213B                              INTEGER
 MESSAGE     61B                              CHAR*45         20


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

    10      34B     FORMAT          30
    20      42B     FORMAT          31


--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

 WARNING      5B      1
```

```
FTN 5.1+552          83/12/24. 09.48.06 PAGE     19
SUBROUTINE WARNING  74/175  OPT=0

--I/O UNITS--(LO=A)
 -NAME--- PROPERTIES-------------

 TAPE6   FMT/SEQ


--STATISTICS--

 PROGRAM-UNIT LENGTH              216B =   142
 CM STORAGE USED                61000B =  25088
 COMPILE TIME                   0.063 SECONDS
```

```
      SUBROUTINE ERROR(IERR)                                          ERROR      1
      CHARACTER*45 MESSAGE(20)                                        ERROR      2
      DATA MESSAGE( 1)/'MATERIALS DATA BASE IS EMPTY             '/   ERROR      3
      DATA MESSAGE( 2)/'FREQUENCY IS OUT OF RANGE                '/   ERROR      4
      DATA MESSAGE( 3)/'THIS MATERIAL IS NOT IN DATA BASE        '/   ERROR      5
      DATA MESSAGE( 4)/'DENOMINATOR IS ZERO                      '/   ERROR      6
      DATA MESSAGE( 5)/'FILE HANDLING ERROR                      '/   ERROR      7
      DATA MESSAGE( 6)/'ERROR CODE IS OUT OF RANGE               '/   ERROR      8
      DATA MESSAGE( 7)/'ERROR CODE IS OUT OF RANGE               '/   ERROR      9
      DATA MESSAGE( 8)/'ERROR CODE IS OUT OF RANGE               '/   ERROR     10
      DATA MESSAGE( 9)/'ERROR CODE IS OUT OF RANGE               '/   ERROR     11
      DATA MESSAGE(10)/'ERROR CODE IS OUT OF RANGE               '/   ERROR     12
      DATA MESSAGE(11)/'ERROR CODE IS OUT OF RANGE               '/   ERROR     13
      DATA MESSAGE(12)/'ERROR CODE IS OUT OF RANGE               '/   ERROR     14
      DATA MESSAGE(13)/'ERROR CODE IS OUT OF RANGE               '/   ERROR     15
      DATA MESSAGE(14)/'ERROR CODE IS OUT OF RANGE               '/   ERROR     16
      DATA MESSAGE(15)/'ERROR CODE IS OUT OF RANGE               '/   ERROR     17
      DATA MESSAGE(16)/'ERROR CODE IS OUT OF RANGE               '/   ERROR     18
      DATA MESSAGE(17)/'ERROR CODE IS OUT OF RANGE               '/   ERROR     19
      DATA MESSAGE(18)/'ERROR CODE IS OUT OF RANGE               '/   ERROR     20
      DATA MESSAGE(19)/'ERROR CODE IS OUT OF RANGE               '/   ERROR     21
      DATA MESSAGE(20)/'ERROR CODE IS OUT OF RANGE               '/   ERROR     22
      IERRM=5                                                         ERROR     23
      IF(IERR.GT.IERRM) IERR=20                                       ERROR     24
      WRITE(6,10) IERR,MESSAGE(IERR)                                  ERROR     25
   10 FORMAT(' ***ERROR NUMBER = ',I5,' ***  ',A45)                   ERROR     26
      CALL PMDSTOP                                                    ERROR     27
      STOP 'ERROR'                                                    ERROR     28
      END                                                             ERROR     29
```

```
--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  IERR        1   DUMMY-ARG                  INTEGER
  IERRM     210B                             INTEGER
  MESSAGE    56B                             CHAR*45        20


--PROCEDURES--(LO=A)
 -NAME------TYPE--------ARGS------CLASS-----

  PMDSTOP                   0       SUBROUTINE


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

     10      36B     FORMAT          26


--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  ERROR       5B     1
```



```
--I/O UNITS--(LO=A)
 -NAME--- PROPERTIES-------------

  TAPE6   FMT/SEQ


--STATISTICS--

  PROGRAM-UNIT LENGTH             213B =  139
  CM STORAGE USED               61000B =  25088
  COMPILE TIME                  0.056 SECONDS
```

Appendix 9.3 Listing of Computer Program SHOLES

```
      PROGRAM SHOLES (INPUT,TAPE1=INPUT)                              SHOLES      1
*                                                                     SHOLES      2
*THIS INTERACTIVE PROGRAM INPUTS THE DATA DESCRIBING EACH HOLE        SHOLES      3
*IN THE BUILDING AND STORES IT.  THE FILE NAME IS CREATED BY          SHOLES      4
*ATTACHING "B" TO THE FRONT OF AND "H" TO THE BACK OF THE BUILDING    SHOLES      5
*IDENTIFICATION. THE BUILDING IDENTIFICATION CAN BE NO MORE           SHOLES      6
*THAN 5 ALPHANUMERIC CHARACTERS.                                      SHOLES      7
                                                                      SHOLES      8
************************************************************************COMF      1
*** COMMON FOR INITIAL PARAMETERS                                    ***COMF      2
************************************************************************COMF      3
      INTEGER FMAX                                                    COMF        4
      PARAMETER (FMAX = 50)                                           COMF        5
      COMMON /INITILN/ FREQ, QUALITY, AFLAG, RFLAG, FREQA(FMAX), FERR,  COMF      6
     $                 FTOT                                           COMF        7
      COMMON /INITILC/ BLDG                                           COMF        8
      CHARACTER * 5 BLDG                                              COMF        9
      REAL FREQ, AFLAG, RFLAG, FREQA                                  COMF       10
      INTEGER QUALITY, FERR, FTOT                                     COMF       11
************************************************************************COMF     12
************************************************************************COMF     13
************************************************************************COMR      1
***   COMMON FOR ROOM ARRAY CONTAINING ATTENUATION OF WALLS          ***COMR      2
************************************************************************COMR      3
      INTEGER RMAX                                                    COMR        4
      PARAMETER (RMAX = 20)                                           COMR        5
      COMMON /ROOMN/ ROOM(RMAX + 6, RMAX + 6), NROOMS, RAREA(RMAX)    COMR        6
      INTEGER NROOMS                                                  COMR        7
      REAL ROOM                                                       COMR        8
************************************************************************COMR      9
************************************************************************COMR     10
************************************************************************COMH      1
***   COMMON FOR DATABASE OF LOCATIONS OF DOORS AND WINDOWS          ***COMH      2
************************************************************************COMH      3
      INTEGER HMAX                                                    COMH        4
      PARAMETER (HMAX = 35)                                           COMH        5
      COMMON /HOLEN/ HTOT, HERR                                       COMH        6
      COMMON /HOLEC/ HOLE(HMAX,4)                                     COMH        7
      INTEGER HTOT, HERR                                              COMH        8
      CHARACTER * 3 HOLE                                              COMH        9
* ==================================================                  COMH       10
* DESCRIPTION OF ARRAYS                                               COMH       11
* ==================================================                  COMH       12
*     ROOM IDENTIFICATION              APERTURE ID                    COMH       13
* ----------------------------------                                  COMH       14
* DIRECTION    FROM ROOM     TO ROOM                                  COMH       15
* --------------------------------------------------                  COMH       16
* HOLE(X,1)    HOLE(X,2)     HOLE(X,3)    HOLE(X,4)                   COMH       17
*   A3            A3            A3           A3                       COMH       18
************************************************************************COMH     19
************************************************************************COMH     20
      INTEGER GETLEN,QUIT,ABORT,ANSWER,OLDFILE,N,Y1,Y2,LINE           SHOLES     12
      INTEGER IERR                                                    SHOLES     13
      CHARACTER * 7  PFN                                              SHOLES     14
*                                                                     SHOLES     15
* INITIALIZATION                                                      SHOLES     16
      QUIT = 0                                                        SHOLES     17
      HTOT = 0                                                        SHOLES     18
      ABORT = 0                                                       SHOLES     19
100   PRINT*                                                          SHOLES     20
      PRINT *, 'ENTER BUILDING IDENTIFICATION  (E.G. ''101'')'        SHOLES     21
      PRINT *, '    (NO MORE THAN 5 ALPHANUMERIC CHARACTERS)'         SHOLES     22
      REWIND 1                                                        SHOLES     23
      READ(1,*,END=100) BLDG                                          SHOLES     24
```

```
                                                                     SHOLES  25
          IF ( GETLEN(BLDG) .GT. 5 ) THEN                            SHOLES  26
            GO TO 100                                                SHOLES  27
          END IF                                                     SHOLES  28
          PFN = 'B' // BLDG(1:GETLEN(BLDG)) // 'H'                   SHOLES  29
*                                                                    SHOLES  30
*** LOAD DATA FROM EXISTING FILE IF NECESSARY                        SHOLES  31
200       PRINT*                                                     SHOLES  32
          PRINT*,'WILL THIS BE'                                      SHOLES  33
          PRINT*,'   (1) A MODIFICATION OF AN EXISTING FILE?'        SHOLES  34
          PRINT*,'   (2) A NEW FILE?'                                SHOLES  35
          PRINT*,'ENTER A NUMBER  !!!'                               SHOLES  36
          REWIND 1                                                   SHOLES  37
          READ(1,*,END=200) OLDFILE                                  SHOLES  38
          IF ( ( OLDFILE .NE. 1 ) .AND. ( OLDFILE .NE. 2 ) ) THEN    SHOLES  39
            GOTO 200                                                 SHOLES  40
          ELSE IF ( OLDFILE .EQ. 1 ) THEN                            SHOLES  41
*                                                                    SHOLES  42
*** CHECK FOR EXISTENCE OF PERMANENT FILE OF SAME NAME               SHOLES  43
            IERR = 0                                                 SHOLES  44
            CALL PF ('GET',0,PFN(1:GETLEN(PFN)),'RC',IERR)           SHOLES  45
            IF ( IERR .EQ. 2 ) THEN                                  SHOLES  46
              PRINT*                                                 SHOLES  47
              PRINT *, 'FILE ',PFN, ' NOT FOUND'                     SHOLES  48
              PRINT*, 'PROGRAM ABORTED!!!'                           SHOLES  49
              PRINT*                                                 SHOLES  50
              PRINT*, 'FIND CORRECT BUILDING IDENTIFIER AND RESTART ',   SHOLES  51
     +                'PROGRAM'                                      SHOLES  52
              PRINT*                                                 SHOLES  53
              STOP                                                   SHOLES  54
*                                                                    SHOLES  55
            ELSE                                                     SHOLES  56
              CALL LHOLE                                             SHOLES  57
              IF (HERR .NE. 0) CALL ERROR(5)                         SHOLES  58
            END IF                                                   SHOLES  59
          ELSE IF ( OLDFILE .EQ. 2 ) THEN                            SHOLES  60
*                                                                    SHOLES  61
*** CHECK FOR EXISTENCE OF PERMANENT FILE OF SAME NAME               SHOLES  62
            IERR = 0                                                 SHOLES  63
            CALL PF ('GET',0,PFN(1:GETLEN(PFN)),'RC',IERR)           SHOLES  64
            IF ( IERR .EQ. 0 ) THEN                                  SHOLES  65
              PRINT*                                                 SHOLES  66
              PRINT*, 'DATA FILE ALREADY EXISTS FOR BUILDING ',BLDG  SHOLES  67
              PRINT*                                                 SHOLES  68
              PRINT*,'IF YOU ENTER DATA AND STORE IT, YOU WILL WRITE ',  SHOLES  69
     +              'OVER THE OLD FILE.'                             SHOLES  70
250           PRINT*                                                 SHOLES  71
              PRINT*,'YOU MAY EITHER (1) ABORT OR (2) CONTINUE.'     SHOLES  72
              PRINT*,'INDICATE YOUR CHOICE BY ENTERING A NUMBER.'    SHOLES  73
              REWIND 1                                               SHOLES  74
              READ(1,*,END=250) ANSWER                               SHOLES  75
              IF ( ANSWER .EQ. 1 ) THEN                              SHOLES  76
                PRINT*                                               SHOLES  77
                PRINT*,'PROGRAM HAS BEEN ABORTED, AT YOUR REQUEST'   SHOLES  78
                PRINT*                                               SHOLES  79
                STOP                                                 SHOLES  80
              ELSE IF ( ANSWER .EQ. 2 ) THEN                         SHOLES  81
                CONTINUE                                             SHOLES  82
TRIVIAL* CONTINUE WITH NO STATEMENT LABEL -- IGNORED
              ELSE                                                   SHOLES  83
                GOTO 250                                             SHOLES  84
              END IF                                                 SHOLES  85
            ELSE IF ( IERR .EQ. 2 ) THEN                             SHOLES  86
*                                                                    SHOLES  87
```

```
*** NO DATA FILE ALREADY EXISTS FOR THIS BUILDING AND DATA ENTRY
*** CAN CONTINUE
          CONTINUE
TRIVIAL* CONTINUE WITH NO STATEMENT LABEL -- IGNORED
        ELSE
*
*** PERMANENT FILE ERROR
          PRINT*
          PRINT*,'PROGRAM ABORTED !!!'
          PRINT*,'   SOME PERMANENT FILE ERROR HAS OCCURRED.'
          PRINT*,'   DOUBLE CHECK YOUR BUILDING IDENTIFICATION ',
     +             'AND TRY AGAIN'
          STOP
        END IF
*
        PRINT*
        PRINT*, ' BEGIN ENTERING DATA'
 300    HTOT = HTOT + 1
        IF ( HTOT .EQ. 1) THEN
          CALL DATAIN(1,HTOT)
        ELSE
          CALL DATAIN (0,HTOT)
        END IF
 400    PRINT*
        PRINT*, 'DO YOU WANT TO ENTER MORE DATA?',
     +             '(1) YES  (2) NO'
        PRINT*, '  ENTER A NUMBER !!!'
        REWIND 1
        READ(1,*,END=400) ANSWER
        IF ( (ANSWER .NE. 1) .AND. (ANSWER .NE. 2) ) THEN
          GOTO 400
        ELSE IF ( ANSWER .EQ. 1) THEN
          GOTO 300
        ELSE IF ( ANSWER .EQ. 2 ) THEN
          PRINT*
          PRINT*, 'DATA ENTRY DISCONTINUED'
        END IF
      END IF
*
*** MANIPULATE DATA
      CALL MANIP (QUIT,ABORT)
*
*** TERMINATE PROGRAM, STORING DATA IF NECESSARY
      IF ( QUIT .EQ. 1 ) THEN
       OPEN(UNIT=6,FILE=PFN(1:GETLEN(PFN)),FORM='FORMATTED',
     +            ACCESS='SEQUENTIAL',STATUS='NEW')
 500    FORMAT (1X,4(1X,A3))
        DO 600 N = 1,HTOT
          WRITE (6,500)(HOLE(N,Y1), Y1=1,4)
 600    CONTINUE
        ENDFILE(6)
        CALL PF ('REPLACE',0,PFN(1:GETLEN(PFN)))
WARNING* NUMBER OF ARGUMENTS IN REFERENCE TO _PF IS NOT CONSISTENT
        CLOSE(6,STATUS='DELETE')
        PRINT*
        PRINT*,'DATA HAS BEEN STORED AND PROGRAM TERMINATED'
      END IF
      IF( ABORT .EQ. 1 ) THEN
        PRINT*
        PRINT*, 'PROGRAM HAS BEEN ABORTED'
        PRINT*,'     NO DATA HAS BEEN STORED !!!'
      END IF
      STOP
      END
```

```
--VARIABLE MAP--(LO=A)
-NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

 ABORT    1054B                             INTEGER
 AFLAG       2B  /INITILN/                  REAL
 ANSWER   1055B                             INTEGER
 BLDG        0B  /INITILC/                  CHAR*5
 FERR       66B  /INITILN/                  INTEGER
 FREQ        0B  /INITILN/                  REAL
 FREQA       4B  /INITILN/                  REAL           50
 FTOT       67B  /INITILN/                  INTEGER
 HERR        1B  /HOLEN/                    INTEGER
 HOLE        0B  /HOLEC/                    CHAR*3        140
 HTOT        0B  /HOLEN/                    INTEGER
 IERR     1061B                             INTEGER
 LINE     NONE             UNUSED/*S*       INTEGER
 N        1057B                             INTEGER
 NROOMS   1244B  /ROOMN/                    INTEGER
 OLDFILE  1056B                             INTEGER
 PFN      1062B                             CHAR*7
 QUALITY     1B  /INITILN/                  INTEGER
 QUIT     1053B                             INTEGER
 RAREA    1245B  /ROOMN/                    REAL           20
 RFLAG       3B  /INITILN/                  REAL
 ROOM        0B  /ROOMN/                    REAL          676
 Y1       1060B                             INTEGER
 Y2       NONE             UNUSED/*S*       INTEGER


--SYMBOLIC CONSTANTS--(LO=A)
-NAME----TYPE------------------------VALUE

 FMAX    INTEGER                        50
 HMAX    INTEGER                        35
 RMAX    INTEGER                        20


--PROCEDURES--(LO=A)
-NAME------TYPE--------ARGS------CLASS-----      -NAME------TYPE--------ARGS------CLASS-----

 DATAIN                   2      SUBROUTINE       LHOLE                    0      SUBROUTINE
 ERROR                    1      SUBROUTINE       MANIP                    2      SUBROUTINE
 GETLEN    INTEGER        1      FUNCTION         PF                       5      SUBROUTINE


--STATEMENT LABELS--(LO=A)
-LABEL-ADDRESS-----PROPERTIES----DEF       -LABEL-ADDRESS-----PROPERTIES----DEF

   100     21B                      60        400     256B                    150
   200     47B                      72        500     606B     FORMAT         173
   250    166B                     111        600  INACTIVE    DO-TERM        176
   300    244B                     144


--ENTRY POINTS--(LO=A)
-NAME---ADDRESS--ARGS---

 SHOLES     14B     0
```

```
--I/O UNITS--(LO=A)
-NAME--- PROPERTIES-------------

 TAPE1   FMT/SEQ
 TAPE6   AUX/FMT/SEQ


--STATISTICS--

 PROGRAM-UNIT LENGTH            1065B =  565
 CM LABELLED COMMON LENGTH      1436B =  798
 CM STORAGE USED               63000B = 26112
 COMPILE TIME                  0.270 SECONDS

      2  TRIVIAL   ERRORS IN SHOLES

      1  WARNING   ERROR IN  SHOLES
```

```
        SUBROUTINE DATAIN (INSERT,LINE)                                SHOLES    150
************************************************************************COMR       1
***   COMMON FOR ROOM ARRAY CONTAINING ATTENUATION OF WALLS          ***COMR       2
************************************************************************COMR       3
      INTEGER RMAX                                                      COMR       4
      PARAMETER (RMAX = 20)                                             COMR       5
      COMMON /ROOMN/ ROOM(RMAX + 6, RMAX + 6), NROOMS, RAREA(RMAX)      COMR       6
      INTEGER NROOMS                                                    COMR       7
      REAL ROOM                                                         COMR       8
************************************************************************COMR       9
************************************************************************COMR      10
************************************************************************COMH       1
***   COMMON FOR DATABASE OF LOCATIONS OF DOORS AND WINDOWS          ***COMH       2
************************************************************************COMH       3
      INTEGER HMAX                                                      COMH       4
      PARAMETER (HMAX = 35)                                             COMH       5
      COMMON /HOLEN/ HTOT, HERR                                         COMH       6
      COMMON /HOLEC/ HOLE(HMAX,4)                                       COMH       7
      INTEGER HTOT, HERR                                                COMH       8
      CHARACTER * 3 HOLE                                                COMH       9
* ==================================================                    COMH      10
* DESCRIPTION OF ARRAYS                                                 COMH      11
* ==================================================                    COMH      12
*     ROOM IDENTIFICATION              APERTURE ID                      COMH      13
* -----------------------------------                                   COMH      14
* DIRECTION    FROM ROOM     TO ROOM                                    COMH      15
* --------------------------------------------------                    COMH      16
* HOLE(X,1)    HOLE(X,2)     HOLE(X,3)    HOLE(X,4)                     COMH      17
*   A3           A3            A3           A3                          COMH      18
************************************************************************COMH      19
************************************************************************COMH      20
        INTEGER  ANSWER,LOK,DOK,NOK,GETLEN,VAL, INSERT,LINE,V           SHOLES    153
        CHARACTER *3 DIR,FROM,TO,ID                                     SHOLES    154
200       PRINT*                                                        SHOLES    155
          PRINT*, 'ENTER DIRECTION (E. G. ''LR'')'                      SHOLES    156
          REWIND 1                                                      SHOLES    157
          READ(1,*,END=200) DIR                                         SHOLES    158
          IF ((DIR .NE. 'LR')                                           SHOLES    159
     +       .AND. (DIR .NE. 'FB')                                      SHOLES    160
     +       .AND. (DIR .NE. 'UD')) THEN                                SHOLES    161
            PRINT*, 'DIRECTION MUST BE ''LR'' OR ''FB'' OR ''UD'''      SHOLES    162
            PRINT*, 'TRY AGAIN!!!'                                      SHOLES    163
            GOTO 200                                                    SHOLES    164
          END IF                                                        SHOLES    165
          HOLE(LINE,1) = DIR                                            SHOLES    166
*         ..................................                            SHOLES    167
 300    PRINT*                                                          SHOLES    168
        PRINT*, 'ENTER "FROM" (E.G. ''02'' OR ''D1'')'                  SHOLES    169
        REWIND 1                                                        SHOLES    170
        READ(1,*,END=300) FROM                                          SHOLES    171
        LOK = 0                                                         SHOLES    172
        DOK = 0                                                         SHOLES    173
        NOK = 0                                                         SHOLES    174
        IF (GETLEN(FROM) .EQ. 2) THEN                                   SHOLES    175
          LOK = 1                                                       SHOLES    176
        END IF                                                          SHOLES    177
        IF (FROM(1:1) .EQ. 'D') THEN                                    SHOLES    178
          V = VAL(FROM(2:2))                                            SHOLES    179
          IF ((V .GE. 1) .AND. (V .LE. 6)) THEN                         SHOLES    180
            DOK = 1                                                     SHOLES    181
          END IF                                                        SHOLES    182
        END IF                                                          SHOLES    183
        IF ((ICHAR(FROM(1:1)) .GE. 16)                                  SHOLES    184
     +     .AND. (ICHAR(FROM(1:1)) .LE. 25)                             SHOLES    185
```

```
     +    .AND. (ICHAR(FROM(2:2)) .GE. 16)
     +    .AND. (ICHAR(FROM(2:2)) .LE. 25)
     +    .AND. (GETLEN(FROM) .EQ. 2)) THEN
         V = VAL(FROM)
         IF ((V .GE. 1) .AND. (V .LE. RMAX)) THEN
           NOK = 1
         END IF
       END IF
       IF ((LOK .EQ. 1) .AND. ((DOK .EQ. 1 ) .OR. (NOK .EQ. 1))) THEN
         HOLE(LINE,2) = FROM
       ELSE
         PRINT*
         PRINT*, 'INCORRECT ENTRY.  TRY AGAIN!!'
         GOTO 300
       END IF
*      ...........................
 400     PRINT*
         PRINT*, 'ENTER "TO"  (E.G. ''02'' OR ''D1'')'
         REWIND 1
         READ(1,*,END=400) TO
         LOK = 0
         DOK = 0
         NOK = 0
         IF (GETLEN(TO) .EQ. 2) THEN
           LOK = 1
         END IF
         IF (TO(1:1) .EQ. 'D') THEN
           V = VAL(TO(2:2))
           IF ((V .GE. 1) .AND. (V .LE. 6)) THEN
             DOK = 1
           END IF
         END IF
         IF ((ICHAR(TO(1:1)) .GE. 16)
     +      .AND. (ICHAR(TO(1:1)) .LE. 25)
     +      .AND. (ICHAR(TO(2:2)) .GE. 16)
     +      .AND. (ICHAR(TO(2:2)) .LE. 25)
     +      .AND. (GETLEN(TO) .EQ. 2)) THEN
           V = VAL (TO)
           IF ((V .GE. 1) .AND. (V .LE. RMAX)) THEN
             NOK = 1
           END IF
         END IF
         IF ((LOK .EQ. 1) .AND. ((DOK .EQ. 1) .OR. (NOK .EQ. 1))) THEN
           HOLE (LINE,3) = TO
         ELSE
           PRINT*
           PRINT*, 'INCORRECT ENTRY.  TRY AGAIN!!'
           GOTO 400
         END IF
         IF(FROM .EQ. TO) THEN
           PRINT*
           PRINT*, 'INCORRECT ENTRY!!'
           PRINT*, '"FROM" CANNOT EQUAL "TO"'
           PRINT*, 'CHECK YOUR DATA AND REENTER "FROM" AND "TO"'
           PRINT*
           GOTO 300
         END IF
         IF ((FROM(1:1) .EQ. 'D' ) .AND. (TO(1:1) .EQ. 'D')) THEN
           PRINT*
           PRINT*,  'INCORRECT ENTRY!!'
           PRINT*, '"FROM" AND "TO" CANNOT BOTH CONTAIN "D"'
           PRINT*, '   CHECK YOUR DATA AND REENTER "FROM" AND "TO"'
           PRINT*
           GOTO 300
```

```
               END IF                                                         SHOLES     250
      *     .. ................................                               SHOLES     251
        500  PRINT*                                                           SHOLES     252
             PRINT*, 'ENTER HOLE ''ID'' (E.G. ''WA'' OR ''DA'')'              SHOLES     253
             REWIND 1                                                         SHOLES     254
             READ (1,*,END=500) ID                                            SHOLES     255
             IF ((( ID(1:1) .EQ. 'D' ) .OR. ( ID(1:1) .EQ. 'W' ))             SHOLES     256
            +    .AND. ( ICHAR(ID(2:2)) .LE. 58 )                             SHOLES     257
            +    .AND. ( ICHAR(ID(2:2)) .GE. 33 )) THEN                       SHOLES     258
               HOLE(LINE,4) = ID                                              SHOLES     259
             ELSE                                                             SHOLES     260
               GOTO 500                                                       SHOLES     261
             END IF                                                           SHOLES     262
      *      ................................                                 SHOLES     263
              RETURN                                                          SHOLES     264
              END                                                             SHOLES     265
```

--VARIABLE MAP--(LO=A)

-NAME	---ADDRESS	--BLOCK	-----PROPERTIES	-------TYPE	---------SIZE
ANSWER	NONE		UNUSED/*S*	INTEGER	
DIR	727B			CHAR*3	
DOK	724B			INTEGER	
FROM	730B			CHAR*3	
HERR	1B	/HOLEN/		INTEGER	
HOLE	0B	/HOLEC/		CHAR*3	140
HTOT	0B	/HOLEN/		INTEGER	
ID	732B			CHAR*3	
INSERT	1	DUMMY-ARG	UNUSED	INTEGER	
LINE	2	DUMMY-ARG		INTEGER	
LOK	723B			INTEGER	
NOK	725B			INTEGER	
NROOMS	1244B	/ROOMN/		INTEGER	
RAREA	1245B	/ROOMN/		REAL	20
ROOM	0B	/ROOMN/		REAL	676
TO	731B			CHAR*3	
V	726B			INTEGER	

--SYMBOLIC CONSTANTS--(LO=A)

-NAME	----TYPE	------------------------VALUE
HMAX	INTEGER	35
RMAX	INTEGER	20

--PROCEDURES--(LO=A)

-NAME	------TYPE	--------ARGS	------CLASS-----
GETLEN	INTEGER	1	FUNCTION
ICHAR	INTEGER	1	INTRINSIC
VAL	INTEGER	1	FUNCTION

--STATEMENT LABELS--(LO=A)

-LABEL	-ADDRESS	-----PROPERTIES	----DEF
200	7B		34
300	46B		47
400	203B		81
500	402B		131

```
SUBROUTINE DATAIN   74/175  OPT=0

--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  DATAIN      5B      2


--I/O UNITS--(LO=A)
 -NAME--- PROPERTIES-------------

  TAPE1   FMT/SEQ


--STATISTICS--

  PROGRAM-UNIT LENGTH              735B =  477
  CM LABELLED COMMON LENGTH       1345B =  741
  CM STORAGE USED                61000B = 25088
  COMPILE TIME                   0.257 SECONDS
```

```
      SUBROUTINE MANIP (QUIT,ABORT)                                     SHOLES     266
************************************************************************COMH         1
***   COMMON FOR DATABASE OF LOCATIONS OF DOORS AND WINDOWS          ***COMH         2
************************************************************************COMH         3
      INTEGER HMAX                                                      COMH         4
      PARAMETER (HMAX = 35)                                             COMH         5
      COMMON /HOLEN/ HTOT, HERR                                         COMH         6
      COMMON /HOLEC/ HOLE(HMAX,4)                                       COMH         7
      INTEGER HTOT, HERR                                                COMH         8
      CHARACTER * 3 HOLE                                                COMH         9
* ==================================================                    COMH        10
* DESCRIPTION OF ARRAYS                                                 COMH        11
* ==================================================                    COMH        12
*     ROOM IDENTIFICATION              APERTURE ID                      COMH        13
* ----------------------------------                                    COMH        14
* DIRECTION    FROM ROOM     TO ROOM                                    COMH        15
* --------------------------------------------------                    COMH        16
* HOLE(X,1)    HOLE(X,2)     HOLE(X,3)    HOLE(X,4)                     COMH        17
*   A3            A3            A3           A3                         COMH        18
************************************************************************COMH        19
************************************************************************COMH        20
      INTEGER ABORT,ANSWER,DOK,FLAG1,LOK,N,NOK,OK,OK1,OK2,QUIT,INSERT   SHOLES     268
      INTEGER TEMP,V,X,Y,COMMAND                                        SHOLES     269
      CHARACTER * 3 DIR, FROM, TO                                       SHOLES     270
*                                                                       SHOLES     271
10    FLAG1 = 0                                                         SHOLES     272
      PRINT*                                                            SHOLES     273
      PRINT*, 'CHOOSE'                                                  SHOLES     274
      PRINT*, '   (1) DISPLAY LINE OF DATA  (4) DISPLAY ALL LINES'      SHOLES     275
      PRINT*, '   (2) INSERT LINE INTO FILE (5) APPEND LINES OF DATA'   SHOLES     276
      PRINT*, '   (3) DELETE LINE           (6) STORE DATA AND EXIT ',  SHOLES     277
     +        'PROGRAM'                                                 SHOLES     278
      PRINT*, '                             (7) EXIT PROGRAM WITHOUT ', SHOLES     279
     +        'STORING DATA'                                            SHOLES     280
      PRINT*, 'ENTER A NUMBER !!!'                                      SHOLES     281
      PRINT*                                                            SHOLES     282
      REWIND 1                                                          SHOLES     283
      READ(1,*,END=10) COMMAND                                          SHOLES     284
*                                                                       SHOLES     285
*---------------------------------------------------------------------- SHOLES     286
*** DISPLAY LINE ***                                                    SHOLES     287
*---------------------------------------------------------------------- SHOLES     288
      IF ( COMMAND .EQ. 1 ) THEN                                        SHOLES     289
*                                                                       SHOLES     290
*** INDICATE EMPTY DATA FILE                                            SHOLES     291
        IF ( HTOT .EQ. 0 ) THEN                                         SHOLES     292
          PRINT*                                                        SHOLES     293
          PRINT*, 'DATA FILE IS EMPTY !!!'                              SHOLES     294
*                                                                       SHOLES     295
*** ENTER NUMBER OF LINE TO BE DISPLAYED                                SHOLES     296
        ELSE                                                            SHOLES     297
100       PRINT*                                                        SHOLES     298
          PRINT*, 'SPECIFY THE NUMBER OF THE LINE TO BE DISPLAYED'      SHOLES     299
          PRINT*, '     ( ENTER "0" TO ESCAPE DISPLAY MODE )'           SHOLES     300
          REWIND 1                                                      SHOLES     301
          READ(1,*,END=100) N                                           SHOLES     302
*                                                                       SHOLES     303
*** CHECK VALIDITY OF LINE NUMBER                                       SHOLES     304
          IF ( (N .GT. HTOT) .OR. (N .LT. 0) ) THEN                     SHOLES     305
            PRINT*                                                      SHOLES     306
            PRINT*, 'INCORRECT NUMBER !!!!!!      TRY AGAIN !!!'        SHOLES     307
            PRINT*, '              -OR-  ENTER "0" TO ESCAPE FROM ',    SHOLES     308
     +              '"DISPLAY" MODE'                                    SHOLES     309
            GOTO 100                                                    SHOLES     310
```

```
*
*** ABORT 'DISPLAY' MODE
            ELSE IF ( N .EQ. 0 ) THEN
              PRINT*
              PRINT*, '     "DISPLAY" MODE ABORTED !!!'
*
*** DISPLAY LINE OF DATA
            ELSE IF ( (N .GT. 0) .AND. (N .LE. HTOT) ) THEN
              PRINT*
              CALL DISPLAY( N, COMMAND)
*
            END IF
          END IF
        END IF
*
*----------------------------------------------------------------------
*** INSERT LINE ***
*----------------------------------------------------------------------
        IF ( COMMAND .EQ. 2 ) THEN
*
*** INDICATE EMPTY DATA FILE
          IF ( HTOT .EQ. 0 ) THEN
            PRINT*
            PRINT*, 'DATA FILE IS EMPTY !!!'
*
*** REQUEST NUMBER OF LINE BEFORE WHICH INSERTION IS TO BE MADE
          ELSE
200         PRINT*
            PRINT*, 'SPECIFY NUMBER OF LINE BEFORE WHICH A NEW LINE IS ',
     +              'TO BE INSERTED'
            PRINT*, '     ( ENTER "0" TO ESCAPE "INSERTION" MODE )'
            REWIND 1
            READ(1,*,END=200) N
*
*** CHECK FOR VALID LINE NUMBER
            IF ( ( N .LT. 0 ) .OR. ( N .GT. HTOT ) ) THEN
              PRINT*
              PRINT*, 'INCORRECT LINE NUMBER !!!'
              PRINT*, '       TRY AGAIN !!!  -OR-  ENTER "0" TO ESCAPE',
     +                '"INSERTION" MODE'
              GOTO 200
*
*** ABORT INSERTION MODE
            ELSE IF ( N .EQ. 0 ) THEN
              PRINT*
              PRINT*, '       "INSERTION" MODE ABORTED'
*
*** MAKE ROOM FOR NEW LINE OF DATA
            ELSE IF ( (N .GT. 0) .AND. (N .LE. HTOT) ) THEN
              DO 230 X = HTOT,N,-1
                DO 210 Y = 1,4
                  HOLE(X+1,Y) = HOLE(X,Y)
210             CONTINUE
230           CONTINUE
*
*** ENTER DATA FOR NEW LINE
              HTOT = HTOT + 1
              CALL DATAIN (1,N)
*
                PRINT*
                PRINT*, 'THE FOLLOWING LINE HAS BEEN ADDED AS LINE ', N
                CALL DISPLAY( N, COMMAND)
            END IF
          END IF
```

```
      END IF
*
*-------------------------------------------------------------------------
*** DELETE LINE ***
*-------------------------------------------------------------------------
      IF ( COMMAND .EQ. 3 ) THEN
*
*** INDICATE EMPTY DATA FILE
        IF ( HTOT .EQ. 0 ) THEN
          PRINT*
          PRINT*, 'DATA FILE IS EMPTY !!!'
*
*** READ NUMBER OF LINE TO BE DELETED
        ELSE
300       PRINT*
          PRINT*, 'SPECIFY THE NUMBER OF THE LINE TO BE DELETED'
          PRINT*, '   (ENTER "0" TO ESCAPE DELETION MODE)'
          REWIND 1
          READ(1,*,END=300) N
*
*** CHECK VALIDITY OF LINE NUMBER
          IF ( (N .GT. HTOT ) .OR. ( N .LT. 0 ) ) THEN
            PRINT*
            PRINT*, ' INCORRECT NUMBER !!!'
            PRINT*, '     TRY AGAIN !!!  -OR-  ENTER "0" TO ESCAPE FROM',
     +              '"DELETE" MODE'
            GOTO 300
*
*** ABORT 'DELETE' MODE
          ELSE IF ( N .EQ. 0 ) THEN
            PRINT*, '  "DELETE" MODE ABORTED'
*
*** DOUBLE CHECK CHOICE OF LINE TO BE DELETED
          ELSE IF (( N .GT. 0 ) .AND. ( N .LE. HTOT )) THEN
            PRINT*
            PRINT*, 'DOUBLE CHECK !!!'
            PRINT*, '     DO YOU WANT TO DELETE THE FOLLOWING LINE?:'
            CALL DISPLAY( N, COMMAND)
305         PRINT*, '   ENTER (1) YES  OR   (2) NO'
            REWIND 1
            READ(1,*,END=305) ANSWER
*
*** DELETE LINE
            IF ( ANSWER .EQ. 1 ) THEN
              DO 330 X = N, HTOT - 1
                DO 310 Y = 1,4
                  HOLE(X,Y) = HOLE(X+1,Y)
310             CONTINUE
330           CONTINUE
              HTOT = HTOT - 1
              PRINT*
              PRINT*, 'LINE # ',N,' DELETED'
            END IF
*
          END IF
        END IF
      END IF
*
*-------------------------------------------------------------------------
*** DISPLAY ALL DATA ***
*-------------------------------------------------------------------------
      IF ( COMMAND .EQ. 4 ) THEN
*
*** INDICATE EMPTY DATA FILE
```

```
             IF ( HTOT .EQ. 0 ) THEN                                     SHOLES      439
               PRINT*                                                    SHOLES      440
               PRINT*, 'DATA FILE IS EMPTY !!!'                          SHOLES      441
      *                                                                  SHOLES      442
      *** DISPLAY DATA                                                   SHOLES      443
             ELSE                                                        SHOLES      444
               PRINT*                                                    SHOLES      445
               CALL DISPLAY( N, COMMAND)                                 SHOLES      446
      *                                                                  SHOLES      447
             END IF                                                      SHOLES      448
           END IF                                                        SHOLES      449
      *                                                                  SHOLES      450
      *----------------------------------------------------------------- SHOLES      451
      *** ADD DATA ***                                                   SHOLES      452
      *----------------------------------------------------------------- SHOLES      453
           IF ( COMMAND .EQ. 5 ) THEN                                    SHOLES      454
      *                                                                  SHOLES      455
      *** ENTER DATA                                                     SHOLES      456
      500    HTOT = HTOT + 1                                             SHOLES      457
             CALL DATAIN (0,HTOT)                                        SHOLES      458
      510    PRINT*                                                      SHOLES      459
             PRINT*, 'DO YOU WANT TO ENTER MORE DATA?   (1) YES  (2) NO'  SHOLES      460
             PRINT*, '   ENTER A NUMBER !!!'                             SHOLES      461
             REWIND 1                                                    SHOLES      462
             READ(1,*,END=510) ANSWER                                    SHOLES      463
      *                                                                  SHOLES      464
      *** CHECK VALIDITY OF NUMBER                                       SHOLES      465
             IF ( ( ANSWER .NE. 1 ) .AND. ( ANSWER .NE. 2 ) ) THEN       SHOLES      466
               GOTO 510                                                  SHOLES      467
      *                                                                  SHOLES      468
      *** ENTER MORE DATA                                                SHOLES      469
             ELSE IF ( ANSWER .EQ. 1 ) THEN                              SHOLES      470
               GOTO 500                                                  SHOLES      471
      *                                                                  SHOLES      472
      *** DISCONTINUE DATA ENTRY                                         SHOLES      473
             ELSE IF ( ANSWER .EQ. 2 ) THEN                              SHOLES      474
               PRINT*                                                    SHOLES      475
               PRINT*, 'DATA ENTRY DISCONTINUED'                         SHOLES      476
      *                                                                  SHOLES      477
             END IF                                                      SHOLES      478
           END IF                                                        SHOLES      479
      *                                                                  SHOLES      480
      *----------------------------------------------------------------- SHOLES      481
      *** STORE DATA AND PROGRAM ***                                     SHOLES      482
      *----------------------------------------------------------------- SHOLES      483
           IF ( COMMAND .EQ. 6 ) THEN                                    SHOLES      484
       600   PRINT*                                                      SHOLES      485
             PRINT*, 'DOUBLE CHECK !!!'                                  SHOLES      486
             PRINT*, '    DO YOU YOU WANT TO STORE THIS DATA AND END PROG'  SHOLES   487
             PRINT*, '  NOTE: STORING THIS DATA WILL WIPE OUT ANY OLD FILE '  SHOLES 488
             PRINT*, '  OF THE SAME NAME !!!'                            SHOLES      489
             PRINT*, '        ENTER A NUMBER: (1) YES   (2) NO'          SHOLES      490
             REWIND 1                                                    SHOLES      491
             READ(1,*,END=600) ANSWER                                    SHOLES      492
      *                                                                  SHOLES      493
      *** SET FLAG FOR STORING DATA IN THE MAIN PROGRAM                  SHOLES      494
             IF ( ANSWER .EQ. 1 ) THEN                                   SHOLES      495
               QUIT = 1                                                  SHOLES      496
               RETURN                                                    SHOLES      497
      *                                                                  SHOLES      498
      *** ABORT 'STORING' MODE                                           SHOLES      499
             ELSE IF ( ANSWER .EQ. 2 ) THEN                              SHOLES      500
               PRINT*                                                    SHOLES      501
               PRINT*, '    "STORING" MODE DISCONTINUED'                 SHOLES      502
```

```
      *                                                                      SHOLES    503
      *** CHECK VALIDITY OF ANSWER                                           SHOLES    504
               ELSE IF ( ( ANSWER .NE. 1 ) .AND. ( ANSWER .NE. 2 ) ) THEN    SHOLES    505
                 GOTO 600                                                    SHOLES    506
      *                                                                      SHOLES    507
               END IF                                                        SHOLES    508
             END IF                                                          SHOLES    509
      *                                                                      SHOLES    510
      *--------------------------------------------------------------------- SHOLES    511
      *** END PROGRAM WITHOUT STORING DATA ***                               SHOLES    512
      *--------------------------------------------------------------------- SHOLES    513
             IF ( COMMAND .EQ. 7 ) THEN                                      SHOLES    514
       700     PRINT*                                                        SHOLES    515
               PRINT*, 'DOUBLE CHECK !!!'                                    SHOLES    516
               PRINT*, '    DO YOU WANT TO END THIS PROGRAM ',               SHOLES    517
          +           'WITHOUT STORING DATA?'                                SHOLES    518
               PRINT*, '        ENTER A NUMBER: (1) YES   (2) NO'            SHOLES    519
               REWIND 1                                                      SHOLES    520
               READ(1,*,END=700) ANSWER                                      SHOLES    521
      *                                                                      SHOLES    522
      *** SET FLAG FOR ABORTING PROGRAM IN THE MAIN PROGRAM                  SHOLES    523
               IF ( ANSWER .EQ. 1 ) THEN                                     SHOLES    524
                 ABORT = 1                                                   SHOLES    525
                 RETURN                                                      SHOLES    526
      *                                                                      SHOLES    527
      *** ABORT 'STORING' MODE                                               SHOLES    528
               ELSE IF ( ANSWER .EQ. 2 ) THEN                                SHOLES    529
                 PRINT*                                                      SHOLES    530
                 PRINT*, '    "ABORTION" MODE DISCONTINUED'                  SHOLES    531
      *                                                                      SHOLES    532
      *** CHECK VALIDITY OF ANSWER                                           SHOLES    533
               ELSE IF ( ( ANSWER .NE. 1 ) .AND. ( ANSWER .NE. 2 ) ) THEN    SHOLES    534
                 GOTO 700                                                    SHOLES    535
      *                                                                      SHOLES    536
               END IF                                                        SHOLES    537
             END IF                                                          SHOLES    538
      *                                                                      SHOLES    539
      *--------------------------------------------------------------------- SHOLES    540
      *** LOOP TO BEGINNING OF 'MANIP' SUBROUTINE                            SHOLES    541
      *--------------------------------------------------------------------- SHOLES    542
             GOTO 10                                                         SHOLES    543
      *                                                                      SHOLES    544
             RETURN                                                          SHOLES    545
TRIVIAL* NO PATH TO THIS STATEMENT
             END                                                             SHOLES    546
```

```
--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  ABORT       2   DUMMY-ARG                   INTEGER
  ANSWER   1400B                              INTEGER
  COMMAND  1405B                              INTEGER
  DIR      NONE              UNUSED/*S*       CHAR*3
  DOK      NONE              UNUSED/*S*       INTEGER
  FLAG1    1401B                              INTEGER
  FROM     NONE              UNUSED/*S*       CHAR*3
  HERR       1B   /HOLEN/                     INTEGER
  HOLE       0B   /HOLEC/                     CHAR*3         140
  HTOT       0B   /HOLEN/                     INTEGER
  INSERT   NONE              UNUSED/*S*       INTEGER
  LOK      NONE              UNUSED/*S*       INTEGER
  N        1402B                              INTEGER
  NOK      NONE              UNUSED/*S*       INTEGER
```

```
 OK       NONE                UNUSED/*S*       INTEGER
 OK1      NONE                UNUSED/*S*       INTEGER
 OK2      NONE                UNUSED/*S*       INTEGER
 QUIT        1   DUMMY-ARG                     INTEGER
 TEMP     NONE                UNUSED/*S*       INTEGER
 TO       NONE                UNUSED/*S*       CHAR*3
 V        NONE                UNUSED/*S*       INTEGER
 X        1403B                                INTEGER
 Y        1404B                                INTEGER


--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE------------------------VALUE

 HMAX    INTEGER                        35


--PROCEDURES--(LO=A)
 -NAME------TYPE--------ARGS------CLASS-----

 DATAIN                   2       SUBROUTINE
 DISPLAY                  2       SUBROUTINE


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF       -LABEL-ADDRESS-----PROPERTIES----DEF

    10       7B                    26          310  INACTIVE   DO-TERM       176
   100      50B                    52          330  INACTIVE   DO-TERM       177
   200     133B                    92          500    437B                   211
   210  INACTIVE   DO-TERM        117          510    443B                   213
   230  INACTIVE   DO-TERM        118          600    504B                   239
   300     263B                   143          700    556B                   269
   305     332B                   167


--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

 MANIP       5B      2


--I/O UNITS--(LO=A)
 -NAME--- PROPERTIES-------------

 TAPE1   FMT/SEQ


--STATISTICS--

 PROGRAM-UNIT LENGTH          1414B =  780
 CM LABELLED COMMON LENGTH      54B =  44
 CM STORAGE USED            63000B =  26112
 COMPILE TIME               0.388 SECONDS

      1  TRIVIAL   ERROR IN  MANIP
```

```
      SUBROUTINE DISPLAY (LINE, COMMAND)                                SHOLES     547
************************************************************************COMH         1
***   COMMON FOR DATABASE OF LOCATIONS OF DOORS AND WINDOWS          ***COMH         2
************************************************************************COMH         3
      INTEGER HMAX                                                      COMH         4
      PARAMETER (HMAX = 35)                                             COMH         5
      COMMON /HOLEN/ HTOT, HERR                                         COMH         6
      COMMON /HOLEC/ HOLE(HMAX,4)                                       COMH         7
      INTEGER HTOT, HERR                                                COMH         8
      CHARACTER * 3 HOLE                                                COMH         9
* ==================================================                    COMH        10
* DESCRIPTION OF ARRAYS                                                 COMH        11
* ==================================================                    COMH        12
*     ROOM IDENTIFICATION           APERTURE ID                         COMH        13
* ----------------------------------                                    COMH        14
* DIRECTION    FROM ROOM     TO ROOM                                    COMH        15
* --------------------------------------------------                    COMH        16
* HOLE(X,1)    HOLE(X,2)     HOLE(X,3)    HOLE(X,4)                     COMH        17
*  A3             A3            A3           A3                         COMH        18
************************************************************************COMH        19
************************************************************************COMH        20
      INTEGER LINE, COMMAND, N                                          SHOLES     549
 1000 FORMAT (8(3X,A))                                                  SHOLES     550
 2000 FORMAT (4X,I3,8X,A3,7X,A3,3X,A3,2X,A3)                            SHOLES     551
      PRINT 1000, 'LINE #','DIRECTION','FROM','TO','ID'                 SHOLES     552
      IF ( COMMAND .EQ. 4 ) THEN                                        SHOLES     553
        DO 10 N = 1,HTOT                                                SHOLES     554
          PRINT 2000, N,HOLE(N,1),HOLE(N,2),HOLE(N,3),HOLE(N,4)         SHOLES     555
 10     CONTINUE                                                        SHOLES     556
      ELSE                                                              SHOLES     557
          PRINT 2000, LINE,HOLE(LINE,1),HOLE(LINE,2),HOLE(LINE,3),      SHOLES     558
     +          HOLE(LINE,4)                                            SHOLES     559
      END IF                                                            SHOLES     560
      RETURN                                                            SHOLES     561
      END                                                               SHOLES     562
```

```
--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

 COMMAND      2   DUMMY-ARG                  INTEGER
 HERR        1B   /HOLEN/                    INTEGER
 HOLE        0B   /HOLEC/                    CHAR*3         140
 HTOT        0B   /HOLEN/                    INTEGER
 LINE         1   DUMMY-ARG                  INTEGER
 N         204B                              INTEGER

--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE------------------------VALUE

 HMAX    INTEGER                         35

--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

   10  INACTIVE   DO-TERM        29
 1000    123B     FORMAT         23
 2000    125B     FORMAT         24
```



```
--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

 DISPLAY      5B      2

--STATISTICS--

 PROGRAM-UNIT LENGTH              210B =   136
 CM LABELLED COMMON LENGTH         54B =    44
 CM STORAGE USED                61000B = 25088
 COMPILE TIME                   0.068 SECONDS
```

```
     1       INTEGER FUNCTION VAL(STRING)                         SHOLES    563
     2 C** RETURNS THE INTEGER VALUE OF A STRING.                 SHOLES    564
     3       INTEGER NUMBER, X,L,EXP,DIGIT,GETLEN                 SHOLES    565
     4       CHARACTER * (*) STRING                               SHOLES    566
     5       L = GETLEN(STRING)                                   SHOLES    567
     6       NUMBER = 0                                           SHOLES    568
     7       DO 10 X = L,1,-1                                     SHOLES    569
     8       EXP = L - X                                          SHOLES    570
     9       DIGIT = ICHAR(STRING(X:X)) - 16                      SHOLES    571
    10       NUMBER = NUMBER + DIGIT*10**EXP                      SHOLES    572
    11 10    CONTINUE                                             SHOLES    573
    12       VAL = NUMBER                                         SHOLES    574
    13       RETURN                                               SHOLES    575
    14       END                                                  SHOLES    576
```

```
--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  DIGIT      76B                            INTEGER
  EXP        75B                            INTEGER
  L          74B                            INTEGER
  NUMBER     72B                            INTEGER
  STRING      1   DUMMY-ARG                 CHAR*(*)
  VAL        71B                            INTEGER
  X          73B                            INTEGER


--PROCEDURES--(LO=A)
 -NAME------TYPE--------ARGS------CLASS-----

  GETLEN    INTEGER        1      FUNCTION
  ICHAR     INTEGER        1      INTRINSIC


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

     10  INACTIVE   DO-TERM        11


--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  VAL         6B     1


--STATISTICS--

  PROGRAM-UNIT LENGTH           102B = 66
  CM STORAGE USED             61000B = 25088
  COMPILE TIME                0.039 SECONDS
```

```
FTN 5 1+552          83/12/24. 09.11.45 PAGE     19
  FUNCTION GETLEN   74/175  OPT=0

     1        INTEGER FUNCTION GETLEN (STRING)                                  SHOLES      577
     2 C                                                                        SHOLES      578
     3 C DETERMINE LENGTH OF STRING EXCLUDING ANY BLANK PADDING                 SHOLES      579
     4 C                                                                        SHOLES      580
     5 C                                                                        SHOLES      581
     6 C ARGUMENT DEFINITIONS --                                                SHOLES      582
     7 C   READ ARGUMENTS                                                       SHOLES      583
     8 C      STRING - STRING WHOSE LENGTH IS TO BE DETERMINED                  SHOLES      584
     9 C                                                                        SHOLES      585
    10        CHARACTER * (*) STRING                                            SHOLES      586
    11 C                                                                        SHOLES      587
    12 C FUNCTION PARAMETERS                                                    SHOLES      588
    13        CHARACTER * 1 BLANK                                               SHOLES      589
    14        PARAMETER (BLANK = ' ')                                           SHOLES      590
    15 C                                                                        SHOLES      591
    16 C LOCAL VARIABLES                                                        SHOLES      592
    17        INTEGER NEXT                                                      SHOLES      593
    18 C                                                                        SHOLES      594
    19 C START WITH THE LAST CHARACTER AND FIND THE FIRST NON-BLANK             SHOLES      595
    20        DO 10 NEXT = LEN(STRING),1,-1                                     SHOLES      596
    21           IF (STRING(NEXT : NEXT) .NE. BLANK) THEN                       SHOLES      597
    22              GETLEN = NEXT                                               SHOLES      598
    23              RETURN                                                      SHOLES      599
    24           END IF                                                         SHOLES      600
    25     10 CONTINUE                                                          SHOLES      601
    26 C                                                                        SHOLES      602
    27 C ALL CHARACTERS ARE BLANKS                                              SHOLES      603
    28        GETLEN = 0                                                        SHOLES      604
    29 C                                                                        SHOLES      605
    30        RETURN                                                            SHOLES      606
    31        END                                                               SHOLES      607

--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  GETLEN     63B                             INTEGER
  NEXT       64B                             INTEGER
  STRING      1   DUMMY-ARG                  CHAR*(*)


--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE------------------------VALUE

  BLANK   CHAR*1                         ' '


--PROCEDURES--(LO=A)
 -NAME------TYPE--------ARGS------CLASS-----

  LEN       INTEGER        1       INTRINSIC


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

    10  INACTIVE   DO-TERM        25
```

```
FTN 5.1+552          83/12/24. 09.11.45 PAGE     20
  FUNCTION GETLEN   74/175  OPT=0

--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  GETLEN     6B     1


--STATISTICS--

  PROGRAM-UNIT LENGTH           70B =  56
  CM STORAGE USED            61000B =  25088
  COMPILE TIME               0.037 SECONDS
```

```
      SUBROUTINE LHOLE                                                  LHOLE    1
*!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!LHOLE    2
*!!!                                                                 !!!LHOLE    3
*!!!  LOAD THE CONTENTS OF THE "HOLE" FILE INTO THE "HOLE" ARRAY     !!!LHOLE    4
*!!!                                                                 !!!LHOLE    5
*!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!LHOLE    6
************************************************************************COMH     1
***   COMMON FOR DATABASE OF LOCATIONS OF DOORS AND WINDOWS          ***COMH     2
************************************************************************COMH     3
      INTEGER HMAX                                                      COMH     4
      PARAMETER (HMAX = 35)                                             COMH     5
      COMMON /HOLEN/ HTOT, HERR                                         COMH     6
      COMMON /HOLEC/ HOLE(HMAX,4)                                       COMH     7
      INTEGER HTOT, HERR                                                COMH     8
      CHARACTER * 3 HOLE                                                COMH     9
* ==================================================                    COMH    10
* DESCRIPTION OF ARRAYS                                                 COMH    11
* ==================================================                    COMH    12
*     ROOM IDENTIFICATION              APERTURE ID                      COMH    13
* -----------------------------------                                   COMH    14
* DIRECTION    FROM ROOM    TO ROOM                                     COMH    15
* --------------------------------------------------                    COMH    16
* HOLE(X,1)    HOLE(X,2)    HOLE(X,3)    HOLE(X,4)                      COMH    17
*   A3           A3           A3           A3                           COMH    18
************************************************************************COMH    19
************************************************************************COMH    20
************************************************************************COMF     1
*** COMMON FOR INITIAL PARAMETERS                                    ***COMF     2
************************************************************************COMF     3
      INTEGER FMAX                                                      COMF     4
      PARAMETER (FMAX = 50)                                             COMF     5
      COMMON /INITILN/ FREQ, QUALITY, AFLAG, RFLAG, FREQA(FMAX), FERR,  COMF     6
     $                 FTOT                                             COMF     7
      COMMON /INITILC/ BLDG                                             COMF     8
      CHARACTER * 5 BLDG                                                COMF     9
      REAL FREQ, AFLAG, RFLAG, FREQA                                    COMF    10
      INTEGER QUALITY, FERR, FTOT                                       COMF    11
************************************************************************COMF    12
************************************************************************COMF    13
      INTEGER GETLEN, R, C                                              LHOLE    9
      CHARACTER * 7  PFN                                                LHOLE   10
      PFN = 'B' // BLDG(1:GETLEN(BLDG)) // 'H'                          LHOLE   11
      HERR = 0                                                          LHOLE   12
      CALL PF  ('GET',0,PFN(1:GETLEN(PFN)),'RC',HERR)                   LHOLE   13
      IF ( HERR .EQ. 0 ) THEN                                           LHOLE   14
        OPEN (UNIT=3, FILE=PFN, FORM='FORMATTED',                       LHOLE   15
     $        STATUS='OLD', ACCESS='SEQUENTIAL')                        LHOLE   16
1000    FORMAT (1X,4(1X,A3))                                            LHOLE   17
        HTOT = 0                                                        LHOLE   18
        DO 10 R = 1,HMAX                                                LHOLE   19
          READ (3,1000,END=20)(HOLE(R,C),C=1,4)                         LHOLE   20
          HTOT = HTOT + 1                                               LHOLE   21
10      CONTINUE                                                        LHOLE   22
20      CONTINUE                                                        LHOLE   23
        CLOSE(3,STATUS='DELETE')                                        LHOLE   24
      ELSE IF ( HERR .EQ. 2 ) THEN                                      LHOLE   25
        CALL WARNING (1)                                                LHOLE   26
      ELSE                                                              LHOLE   27
        CALL WARNING (2)                                                LHOLE   28
      END IF                                                            LHOLE   29
      RETURN                                                            LHOLE   30
      END                                                               LHOLE   31
```

```
 SUBROUTINE LHOLE     74/175  OPT=0

--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  AFLAG        2B  /INITILN/                     REAL
  BLDG         0B  /INITILC/                     CHAR*5
  C          214B                                INTEGER
  FERR        66B  /INITILN/                     INTEGER
  FREQ         0B  /INITILN/                     REAL
  FREQA        4B  /INITILN/                     REAL            50
  FTOT        67B  /INITILN/                     INTEGER
  HERR         1B  /HOLEN/                       INTEGER
  HOLE         0B  /HOLEC/                       CHAR*3         140
  HTOT         0B  /HOLEN/                       INTEGER
  PFN        215B                                CHAR*7
  QUALITY      1B  /INITILN/                     INTEGER
  R          213B                                INTEGER
  RFLAG        3B  /INITILN/                     REAL


--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE------------------------VALUE

  FMAX    INTEGER                          50
  HMAX    INTEGER                          35


--PROCEDURES--(LO=A)
 -NAME------TYPE--------ARGS------CLASS-----

  GETLEN    INTEGER         1       FUNCTION
  PF                        5       SUBROUTINE
  WARNING                   1       SUBROUTINE


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

     10  INACTIVE   DO-TERM        53
     20     73B                    54
   1000    130B     FORMAT         48


--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  LHOLE       5B     0


--I/O UNITS--(LO=A)
 -NAME--- PROPERTIES------------

  TAPE3   AUX/FMT/SEQ


--STATISTICS--

  PROGRAM-UNIT LENGTH            222B =  146
  CM LABELLED COMMON LENGTH      145B =  101
  CM STORAGE USED              61000B =  25088
  COMPILE TIME                 0.086 SECONDS
```

```
      SUBROUTINE ERROR(IERR)                                            ERROR      1
      CHARACTER*45 MESSAGE(20)                                          ERROR      2
      DATA MESSAGE( 1)/'MATERIALS DATA BASE IS EMPTY                 '/ ERROR      3
      DATA MESSAGE( 2)/'FREQUENCY IS OUT OF RANGE                    '/ ERROR      4
      DATA MESSAGE( 3)/'THIS MATERIAL IS NOT IN DATA BASE            '/ ERROR      5
      DATA MESSAGE( 4)/'DENOMINATOR IS ZERO                          '/ ERROR      6
      DATA MESSAGE( 5)/'FILE HANDLING ERROR                          '/ ERROR      7
      DATA MESSAGE( 6)/'ERROR CODE IS OUT OF RANGE                   '/ ERROR      8
      DATA MESSAGE( 7)/'ERROR CODE IS OUT OF RANGE                   '/ ERROR      9
      DATA MESSAGE( 8)/'ERROR CODE IS OUT OF RANGE                   '/ ERROR     10
      DATA MESSAGE( 9)/'ERROR CODE IS OUT OF RANGE                   '/ ERROR     11
      DATA MESSAGE(10)/'ERROR CODE IS OUT OF RANGE                   '/ ERROR     12
      DATA MESSAGE(11)/'ERROR CODE IS OUT OF RANGE                   '/ ERROR     13
      DATA MESSAGE(12)/'ERROR CODE IS OUT OF RANGE                   '/ ERROR     14
      DATA MESSAGE(13)/'ERROR CODE IS OUT OF RANGE                   '/ ERROR     15
      DATA MESSAGE(14)/'ERROR CODE IS OUT OF RANGE                   '/ ERROR     16
      DATA MESSAGE(15)/'ERROR CODE IS OUT OF RANGE                   '/ ERROR     17
      DATA MESSAGE(16)/'ERROR CODE IS OUT OF RANGE                   '/ ERROR     18
      DATA MESSAGE(17)/'ERROR CODE IS OUT OF RANGE                   '/ ERROR     19
      DATA MESSAGE(18)/'ERROR CODE IS OUT OF RANGE                   '/ ERROR     20
      DATA MESSAGE(19)/'ERROR CODE IS OUT OF RANGE                   '/ ERROR     21
      DATA MESSAGE(20)/'ERROR CODE IS OUT OF RANGE                   '/ ERROR     22
      IERRM=5                                                           ERROR     23
      IF(IERR.GT.IERRM) IERR=20                                         ERROR     24
      WRITE(6,10) IERR,MESSAGE(IERR)                                    ERROR     25
   10 FORMAT(' ***ERROR NUMBER = ',I5,' ***  ',A45)                     ERROR     26
      CALL PMDSTOP                                                      ERROR     27
      STOP 'ERROR'                                                      ERROR     28
      END                                                               ERROR     29
```

```
--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  IERR   .    1   DUMMY-ARG                  INTEGER
  IERRM     210B                             INTEGER
  MESSAGE    56B                             CHAR*45        20


--PROCEDURES--(LO=A)
 -NAME------TYPE--------ARGS------CLASS-----

  PMDSTOP                  0       SUBROUTINE


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

    10      36B     FORMAT          26


--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  ERROR       5B      1
```

FTN 5.1+552   83/12/24. 09.11.45 PAGE   24
SUBROUTINE ERROR   74/175 OPT=0

```
--I/O UNITS--(LO=A)
 -NAME--- PROPERTIES------------

  TAPE6   FMT/SEQ


--STATISTICS--

  PROGRAM-UNIT LENGTH                213B =  139
  CM STORAGE USED                  61000B =  25088
  COMPILE TIME                     0.055 SECONDS
```

```
FTN 5 1+552          83/12/24  09 11.45 PAGE     25
SUBROUTINE WARNING  74/175  OPT=0

     1        SUBROUTINE WARNING(ERR)                                                WARNING      1
     2        INTEGER ERR, ERRM                                                      WARNING      2
     3        CHARACTER*45 MESSAGE(20)                                               WARNING      3
     4        DATA MESSAGE( 1)/'"HOLE" DATA FILE DOES NOT EXIST FOR THIS BLDG'/ WARNING      4
     5        DATA MESSAGE( 2)/'FILE HANDLING PROBLEM ON "HOLE" DATA FILE     '/ WARNING      5
     6        DATA MESSAGE( 3)/'"MATTER" FILE DOES NOT EXIST FOR THIS BLDG    '/ WARNING      6
     7        DATA MESSAGE( 4)/'FILE HANDLING PROBLEM ON "MATTER FILE         '/ WARNING      7
     8        DATA MESSAGE( 5)/'"TYPE" DATA FILE DOES NOT EXIST FOR THIS BLDG'/ WARNING      8
     9        DATA MESSAGE( 6)/'FILE HANDLING PROBLEM ON "TYPE" FILE          '/ WARNING      9
    10        DATA MESSAGE( 7)/'"WALL" DATA FILE DOES NOT EXIST FOR THIS BLDG'/ WARNING     10
    11        DATA MESSAGE( 8)/'FILE HANDLING PROBLEM ON "WALL" FILE          '/ WARNING     11
    12        DATA MESSAGE( 9)/'HEIGHT AND WIDTH OF ROOM MISSING              '/ WARNING     12
    13        DATA MESSAGE(10)/'LENGTH OF ROOM IS MISSING                     '/ WARNING     13
    14        DATA MESSAGE(11)/'FREQ FILE DOES NOT EXIST FOR THIS BLDG        '/ WARNING     14
    15        DATA MESSAGE(12)/'FILE HANDLING PROBLEM WITH FREQ FILE          '/ WARNING     15
    16        DATA MESSAGE(13)/'WARNING CODE IS OUT OF RANGE                  '/ WARNING     16
    17        DATA MESSAGE(14)/'WARNING CODE IS OUT OF RANGE                  '/ WARNING     17
    18        DATA MESSAGE(15)/'WARNING CODE IS OUT OF RANGE                  '/ WARNING     18
    19        DATA MESSAGE(16)/'WARNING CODE IS OUT OF RANGE                  '/ WARNING     19
    20        DATA MESSAGE(17)/'WARNING CODE IS OUT OF RANGE                  '/ WARNING     20
    21        DATA MESSAGE(18)/'WARNING CODE IS OUT OF RANGE                  '/ WARNING     21
    22        DATA MESSAGE(19)/'WARNING CODE IS OUT OF RANGE                  '/ WARNING     22
    23        DATA MESSAGE(20)/'WARNING CODE IS OUT OF RANGE                  '/ WARNING     23
    24        ERRM=12                                                                WARNING     24
    25        IERR = ERR                                                             WARNING     25
    26        IF(ERR.GT.ERRM) IERR=20                                                WARNING     26
    27        WRITE(6,20)                                                            WARNING     27
    28        WRITE(6,10) ERR,MESSAGE(IERR)                                          WARNING     28
    29        WRITE(6,20)                                                            WARNING     29
    30 10     FORMAT(' ***WARNING NUMBER = ',I5,' ***  ',A45)                        WARNING     30
    31 20     FORMAT('     ')                                                        WARNING     31
    32        RETURN                                                                 WARNING     32
    33        END                                                                    WARNING     33

--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  ERR         1   DUMMY-ARG                  INTEGER
  ERRM       60B                             INTEGER
  IERR      213B                             INTEGER
  MESSAGE    61B                             CHAR*45        20


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

    10      34B     FORMAT         30
    20      42B     FORMAT         31


--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  WARNING     5B     1
```

```
FTN 5.1+552          83/12/24. 09.11.45 PAGE     26
SUBROUTINE WARNING  74/175  OPT=0

--I/O UNITS--(LO=A)
 -NAME--- PROPERTIES------------

  TAPE6   FMT/SEQ


--STATISTICS--

  PROGRAM-UNIT LENGTH              216B =  142
  CM STORAGE USED                61000B =  25088
  COMPILE TIME                   0.057 SECONDS
```

Appendix 9.4 Listing of Computer Program SWALLS

```
      PROGRAM SWALLS (INPUT,TAPE1=INPUT)                                SWALLS      1
*                                                                       SWALLS      2
*THIS INTERACTIVE PROGRAM INPUTS THE DATA DESCRIBING EACH WALL           SWALLS      3
*IN THE BUILDING AND STORES IT.  THE FILE NAME IS CREATED BY            SWALLS      4
*ATTACHING "B" TO THE FRONT OF AND "W" TO THE BACK OF THE BUILDING      SWALLS      5
*IDENTIFICATION. THE BUILDING IDENTIFICATION CAN BE NO MORE             SWALLS      6
*THAN 5 ALPHANUMERIC CHARACTERS.                                        SWALLS      7
                                                                        SWALLS      8
************************************************************************COMF        1
*** COMMON FOR INITIAL PARAMETERS                                    ***COMF        2
************************************************************************COMF        3
      INTEGER FMAX                                                      COMF        4
      PARAMETER (FMAX = 50)                                             COMF        5
      COMMON /INITILN/ FREQ, QUALITY, AFLAG, RFLAG, FREQA(FMAX), FERR,  COMF        6
     $                 FTOT                                             COMF        7
      COMMON /INITILC/ BLDG                                             COMF        8
      CHARACTER * 5 BLDG                                                COMF        9
      REAL FREQ, AFLAG, RFLAG, FREQA                                    COMF       10
      INTEGER QUALITY, FERR, FTOT                                       COMF       11
************************************************************************COMF       12
************************************************************************COMF       13
************************************************************************COMR        1
***   COMMON FOR ROOM ARRAY CONTAINING ATTENUATION OF WALLS          ***COMR        2
************************************************************************COMR        3
      INTEGER RMAX                                                      COMR        4
      PARAMETER (RMAX = 20)                                             COMR        5
      COMMON /ROOMN/ ROOM(RMAX + 6, RMAX + 6), NROOMS, RAREA(RMAX)      COMR        6
      INTEGER NROOMS                                                    COMR        7
      REAL ROOM                                                         COMR        8
************************************************************************COMR        9
************************************************************************COMR       10
************************************************************************COMW        1
***   COMMON FOR DATABASE OF WALL PARAMETERS                         ***COMW        2
************************************************************************COMW        3
      INTEGER WMAX                                                      COMW        4
      PARAMETER (WMAX = 75)                                             COMW        5
      COMMON /WALLN/ WDIM(WMAX,3), WTOT, WERR                           COMW        6
      COMMON /WALLC/ WALL(WMAX,4)                                       COMW        7
      INTEGER WTOT,WERR                                                 COMW        8
      REAL WDIM                                                         COMW        9
      CHARACTER *3 WALL                                                 COMW       10
* =================================                                     COMW       11
** DESCRIPTION OF ARRAYS                                                COMW       12
* =================================                                     COMW       13
*    WALL IDENTIFICATION                                                COMW       14
* ---------------------------------                                     COMW       15
* DIRECTION    FROM       TO                                            COMW       16
*              ROOM       ROOM                                          COMW       17
* ---------------------------------                                     COMW       18
* WALL(X,1)   WALL(X,2)   WALL(X,3)                                     COMW       19
*  A3          A3          A3                                           COMW       20
* ======================================================                COMW       21
*        WALL PARAMETERS                                                COMW       22
* ------------------------------------------------------                COMW       23
* MATERIAL    HEIGHT      WIDTH       LAYER THICKNESS                   COMW       24
* ------------------------------------------------------                COMW       25
* WALL(X,4)   WDIM(X,1)   WDIM(X,2)   WDIM(X,3)                         COMW       26
*  A3          F8.2        F8.2        F8.2                             COMW       27
************************************************************************COMW       28
************************************************************************COMW       29
      INTEGER GETLEN,QUIT,ABORT,ANSWER,OLDFILE,N,Y1,Y2,LINE             SWALLS     12
      INTEGER IERR                                                      SWALLS     13
      CHARACTER * 7  PFN                                                SWALLS     14
*                                                                       SWALLS     15
```

```
* INITIALIZATION
      QUIT = 0
      WTOT = 0
      ABORT = 0
100   PRINT*
      PRINT *, 'ENTER BUILDING IDENTIFICATION  (E.G. ''101'')'
      PRINT *, '    (NO MORE THAN 5 ALPHANUMERIC CHARACTERS)'
      REWIND 1
      READ(1,*,END=100) BLDG

      IF ( GETLEN(BLDG) .GT. 5 ) THEN
        GO TO 100
      END IF
      PFN = 'B' // BLDG(1:GETLEN(BLDG)) // 'W'
*
*** LOAD DATA FROM EXISTING FILE IF NECESSARY
200   PRINT*
      PRINT*,'WILL THIS BE'
      PRINT*,'   (1) A MODIFICATION OF AN EXISTING FILE?'
      PRINT*,'   (2) A NEW FILE?'
      PRINT*,'ENTER A NUMBER  !!!'
      REWIND 1
      READ(1,*,END=200) OLDFILE
      IF ( ( OLDFILE .NE. 1 ) .AND. ( OLDFILE .NE. 2 ) ) THEN
        GOTO 200
      ELSE IF ( OLDFILE .EQ. 1 ) THEN
*
*** CHECK FOR EXISTENCE OF PERMANENT FILE OF SAME NAME
        IERR = 0
        CALL PF ('GET',0,PFN(1:GETLEN(PFN)),'RC',IERR)
        IF ( IERR .EQ. 2 ) THEN
          PRINT*
          PRINT *, 'FILE ',PFN, ' NOT FOUND'
          PRINT*, 'PROGRAM ABORTED!!!'
          PRINT*
          PRINT*, 'FIND CORRECT BUILDING IDENTIFIER AND RESTART ',
     +              'PROGRAM'
          PRINT*
          STOP
*
        ELSE
          CALL LWALL
          IF (WERR .NE. 0) CALL ERROR(5)
        ENDIF
      ELSE IF ( OLDFILE .EQ. 2 ) THEN
*
*** CHECK FOR EXISTENCE OF PERMANENT FILE OF SAME NAME
        IERR = 0
        CALL PF ('GET',0,PFN(1:GETLEN(PFN)),'RC',IERR)
        IF ( IERR .EQ. 0 ) THEN
          PRINT*
          PRINT*, 'DATA FILE ALREADY EXISTS FOR BUILDING ',BLDG
          PRINT*
          PRINT*,'IF YOU ENTER DATA AND STORE IT, YOU WILL WRITE ',
     +              'OVER THE OLD FILE.'
250       PRINT*
          PRINT*,'YOU MAY EITHER (1) ABORT OR (2) CONTINUE.'
          PRINT*,'INDICATE YOUR CHOICE BY ENTERING A NUMBER.'
          REWIND 1
          READ(1,*,END=250) ANSWER
            PRINT*
            PRINT*,'PROGRAM HAS BEEN ABORTED, PER YOUR REQUEST'
            PRINT*
          IF ( ANSWER .EQ. 1 ) THEN
```

```
             STOP
           ELSE IF ( ANSWER .EQ. 2 ) THEN
 9090        CONTINUE
           ELSE
             GOTO 250
           ENDIF
         ELSE IF ( IERR .EQ. 2 ) THEN
 *
 *         NO DATA FILE EXISTS FOR THIS BUILDING AND DATA ENTRY
 *         CAN CONTINUE
 *
 9091      CONTINUE
         ELSE
 *
 *         **PERMANENT FILE ERROR
 *
           PRINT*
           PRINT*,'PROGRAM ABORTED !!!'
           PRINT*,'  SOME PERMANENT FILE ERROR HAS OCCURRED'
           PRINT*,'  DOUBLE CHECK YOUR BUILDING IDENTIFICATION ',
      +             'AND TRY AGAIN'
           STOP
         ENDIF
         PRINT*
         PRINT*, ' BEGIN ENTERING DATA'
 ***************************************************************
 *   CHECK TO SEE IF THERE IS ENOUGH ARRAY SPACE
 ***************************************************************
 300   IF(WTOT.GE.WMAX) THEN
       WTOT = WMAX
       PRINT *, 'DATA ENTRY ABORTED.'
       PRINT *, 'MAXIMUM NUMBER OF DATA LINES IN FILE WOULD'
       PRINT *, ' HAVE BEEN EXCEEDED. NO MORE THAN ',WMAX
       PRINT *, ' DATA LINES ARE ALLOWED.'
       PRINT *, ' TO INCREASE THE MAXIMUM NUMBER OF ENTRIES ALLOWED,'
       PRINT *, ' CHANGE THE PARAMETER "WMAX" IN EACH COMMON OF'
       PRINT *, ' EVERY SUBROUTINE (THERE ARE FOUR PLACES).'
       PRINT *, ' THEN RECOMPILE THE PROGRAM.'
       GOTO 450
       ENDIF
 ***************************************************************
         WTOT = WTOT + 1
         IF ( WTOT .EQ. 1) THEN
           CALL DATAIN(1,WTOT)
         ELSE
           CALL DATAIN (0,WTOT)
         END IF
 400     PRINT*
         PRINT*, 'DO YOU WANT TO ENTER MORE DATA?',
      +            '(1) YES  (2) NO'
         PRINT*, '  ENTER A NUMBER !!!'
         REWIND 1
         READ(1,*,END=400) ANSWER
         IF ( (ANSWER .NE. 1) .AND. (ANSWER .NE. 2) ) THEN
           GOTO 400
         ELSE IF ( ANSWER .EQ. 1) THEN
           GOTO 300
         ELSE IF ( ANSWER .EQ. 2 ) THEN
           PRINT*
           PRINT*, 'DATA ENTRY DISCONTINUED'
         END IF
       END IF
 *
 *** MANIPULATE DATA
```

```
450   CALL MANIP (QUIT,ABORT)
*
*** TERMINATE PROGRAM, STORING DATA IF NECESSARY
      IF ( QUIT .EQ. 1 ) THEN
       OPEN(UNIT=6,FILE=PFN(1:GETLEN(PFN)),FORM='FORMATTED',
     +          ACCESS='SEQUENTIAL',STATUS='NEW')
500     FORMAT (1X,4(1X,A3),3(1X,F8.2))
        DO 600 N = 1,WTOT
          WRITE (6,500)(WALL(N,Y1), Y1=1,4),(WDIM(N,Y2), Y2=1,3)
600     CONTINUE
        ENDFILE(6)
        CALL PF ('REPLACE',0,PFN(1:GETLEN(PFN)))
WARNING* NUMBER OF ARGUMENTS IN REFERENCE TO _PF IS NOT CONSISTENT
        CLOSE(6,STATUS='DELETE')
        PRINT*
        PRINT*,'DATA HAS BEEN STORED AND PROGRAM TERMINATED'
      END IF
      IF( ABORT .EQ. 1 ) THEN
        PRINT*
        PRINT*, 'PROGRAM HAS BEEN ABORTED'
        PRINT*,'      NO DATA HAS BEEN STORED !!!'
      END IF
      STOP
      END
```

--VARIABLE MAP--(LO=A)

-NAME	---ADDRESS	--BLOCK	-----PROPERTIES	-------TYPE	---------SIZE
ABORT	1216B			INTEGER	
AFLAG	2B	/INITILN/		REAL	
ANSWER	1217B			INTEGER	
BLDG	0B	/INITILC/		CHAR*5	
FERR	66B	/INITILN/		INTEGER	
FREQ	0B	/INITILN/		REAL	
FREQA	4B	/INITILN/		REAL	50
FTOT	67B	/INITILN/		INTEGER	
IERR	1224B			INTEGER	
LINE	NONE		UNUSED/*S*	INTEGER	
N	1221B			INTEGER	
NROOMS	1244B	/ROOMN/		INTEGER	
OLDFILE	1220B			INTEGER	
PFN	1225B			CHAR*7	
QUALITY	1B	/INITILN/		INTEGER	
QUIT	1215B			INTEGER	
RAREA	1245B	/ROOMN/		REAL	20
RFLAG	3B	/INITILN/		REAL	
ROOM	0B	/ROOMN/		REAL	676
WALL	0B	/WALLC/		CHAR*3	300
WDIM	0B	/WALLN/		REAL	225
WERR	342B	/WALLN/		INTEGER	
WTOT	341B	/WALLN/		INTEGER	
Y1	1222B			INTEGER	
Y2	1223B			INTEGER	

--SYMBOLIC CONSTANTS--(LO=A)

-NAME	----TYPE	------------------------VALUE
FMAX	INTEGER	50
RMAX	INTEGER	20
WMAX	INTEGER	75

```
--PROCEDURES--(LO=A)
 -NAME------TYPE--------ARGS------CLASS-----       -NAME------TYPE--------ARGS------CLASS-----

  DATAIN                   2       SUBROUTINE       LWALL                      0       SUBROUTINE
  ERROR                    1       SUBROUTINE       MANIP                      2       SUBROUTINE
  GETLEN    INTEGER        1       FUNCTION         PF                         5       SUBROUTINE


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF       -LABEL-ADDRESS-----PROPERTIES----DEF

    100      21B                    69          450     344B                        193
    200      47B                    81          500     714B     FORMAT             199
    250     166B                   120          600  INACTIVE    DO-TERM            202
    300     246B                   157         9090 *NO REFS*                       131
    400     306B                   176         9091 *NO REFS*                       140


--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  SWALLS     14B     0


--I/O UNITS--(LO=A)
 -NAME--- PROPERTIES------------

  TAPE1   FMT/SEQ
  TAPE6   AUX/FMT/SEQ


--STATISTICS--

  PROGRAM-UNIT LENGTH           1231B =  665
  CM LABELLED COMMON LENGTH     2057B =  1071
  CM STORAGE USED              63000B =  26112
  COMPILE TIME                 0.317 SECONDS

      1  WARNING   ERROR IN  SWALLS
```

```
       SUBROUTINE DATAIN (INSERT,LINE)                                  SWALLS    167
************************************************************************COMR        1
***   COMMON FOR ROOM ARRAY CONTAINING ATTENUATION OF WALLS          ***COMR        2
************************************************************************COMR        3
      INTEGER RMAX                                                      COMR        4
      PARAMETER (RMAX = 20)                                             COMR        5
      COMMON /ROOMN/ ROOM(RMAX + 6, RMAX + 6), NROOMS, RAREA(RMAX)      COMR        6
      INTEGER NROOMS                                                    COMR        7
      REAL ROOM                                                         COMR        8
************************************************************************COMR        9
************************************************************************COMR       10
************************************************************************COMW        1
***   COMMON FOR DATABASE OF WALL PARAMETERS                         ***COMW        2
************************************************************************COMW        3
      INTEGER WMAX                                                      COMW        4
      PARAMETER (WMAX = 75)                                             COMW        5
      COMMON /WALLN/ WDIM(WMAX,3), WTOT, WERR                           COMW        6
      COMMON /WALLC/ WALL(WMAX,4)                                       COMW        7
      INTEGER WTOT,WERR                                                 COMW        8
      REAL WDIM                                                         COMW        9
      CHARACTER *3 WALL                                                 COMW       10
* =================================                                     COMW       11
** DESCRIPTION OF ARRAYS                                                COMW       12
* =================================                                     COMW       13
*    WALL IDENTIFICATION                                                COMW       14
* ---------------------------------                                     COMW       15
* DIRECTION    FROM       TO                                            COMW       16
*              ROOM       ROOM                                          COMW       17
* ---------------------------------                                     COMW       18
* WALL(X,1)   WALL(X,2)   WALL(X,3)                                     COMW       19
*  A3          A3          A3                                           COMW       20
* =========================================================             COMW       21
*       WALL PARAMETERS                                                 COMW       22
* ---------------------------------------------------------             COMW       23
* MATERIAL    HEIGHT      WIDTH       LAYER THICKNESS                   COMW       24
* ---------------------------------------------------------             COMW       25
* WALL(X,4)   WDIM(X,1)   WDIM(X,2)   WDIM(X,3)                         COMW       26
*  A3         F8.2        F8.2        F8.2                              COMW       27
************************************************************************COMW       28
************************************************************************COMW       29
       INTEGER  ANSWER,LOK,DOK,NOK,GETLEN,VAL, INSERT,LINE,V            SWALLS    170
       CHARACTER *3 DIR,FROM,TO,MAT                                     SWALLS    171
   99  IF ( INSERT .EQ. 1 ) THEN                                        SWALLS    172
         ANSWER = 1                                                     SWALLS    173
         INSERT = 1                                                     SWALLS    174
       ELSE                                                             SWALLS    175
100      PRINT*                                                         SWALLS    176
         PRINT*, 'IS THIS THE FIRST LAYER OF A WALL   (1) YES (2) NO'   SWALLS    177
         PRINT*, '     ENTER "0" TO ESCAPE "DATA ENTRY" MODE'           SWALLS    178
         PRINT*, ' ENTER A NUMBER!!'                                    SWALLS    179
         REWIND 1                                                       SWALLS    180
         READ(1,*,END=100) ANSWER                                       SWALLS    181
       END IF                                                           SWALLS    182
*      ......................................                           SWALLS    183
       IF (ANSWER .EQ. 0)  THEN                                         SWALLS    184
         WTOT = WTOT - 1                                                SWALLS    185
         PRINT*                                                         SWALLS    186
         PRINT*, 'DATA ENTRY MODE ABORTED'                              SWALLS    187
       END IF                                                           SWALLS    188
       IF ((ANSWER .NE. 2)                                              SWALLS    189
     +    .AND. (ANSWER .NE. 1)                                         SWALLS    190
     +    .AND. (ANSWER .NE. 0)) THEN                                   SWALLS    191
         PRINT*                                                         SWALLS    192
         PRINT*, 'INCORRECT NUMBER!!'                                   SWALLS    193
```

```
          PRINT*, ' TRY AGAIN!! -OR- ENTER "0" TO ESCAPE DATA ENTRY MODE'
          GOTO 99
        END IF
        IF (ANSWER .EQ. 1) THEN
 200      PRINT*
          PRINT*, 'ENTER DIRECTION (E. G. ''LR'')'
          REWIND 1
          READ(1,*,END=200) DIR
          IF ((DIR .NE. 'LR')
     +        .AND. (DIR .NE. 'FB')
     +        .AND. (DIR .NE. 'UD')) THEN
            PRINT*, 'DIRECTION MUST BE ''LR'' OR ''FB'' OR ''UD'''
            PRINT*, 'TRY AGAIN!!!'
            GOTO 200
          END IF
          WALL(LINE,1) = DIR
*        ..................................
  300   PRINT*
        PRINT*, 'ENTER "FROM" (E.G. ''02'' OR ''D1'')'
        REWIND 1
        READ(1,*,END=300) FROM
        LOK = 0
        DOK = 0
        NOK = 0
        IF (GETLEN(FROM) .EQ. 2) THEN
          LOK = 1
        END IF
        IF (FROM(1:1) .EQ. 'D') THEN
          V = VAL(FROM(2:2))
          IF ((V .GE. 1) .AND. (V .LE. 6)) THEN
            DOK = 1
          END IF
        END IF
        IF ((ICHAR(FROM(1:1)) .GE. 16)
     +     .AND. (ICHAR(FROM(1:1)) .LE. 25)
     +     .AND. (ICHAR(FROM(2:2)) .GE. 16)
     +     .AND. (ICHAR(FROM(2:2)) .LE. 25)
     +     .AND. (GETLEN(FROM) .EQ. 2)) THEN
          V = VAL(FROM)
          IF ((V .GE. 1) .AND. (V .LE. RMAX)) THEN
            NOK = 1
          END IF
        END IF
        IF ((LOK .EQ. 1) .AND. ((DOK .EQ. 1 ) .OR. (NOK .EQ. 1))) THEN
          WALL(LINE,2) = FROM
        ELSE
          PRINT*
          PRINT*, 'INCORRECT ENTRY.  TRY AGAIN!!'
          GOTO 300
        END IF
*       ...........................
 400      PRINT*
          PRINT*, 'ENTER "TO"  (E.G. ''02'' OR ''D1'')'
          REWIND 1
          READ(1,*,END=400) TO
          LOK = 0
          DOK = 0
          NOK = 0
          IF (GETLEN(TO) .EQ. 2) THEN
            LOK = 1
          END IF
          IF (TO(1:1) .EQ. 'D') THEN
            V = VAL(TO(2:2))
            IF ((V .GE. 1) .AND. (V .LE. 6)) THEN
```

```
                DOK = 1                                                SWALLS     258
              END IF                                                   SWALLS     259
            ENDIF                                                      SWALLS     260
            IF ((ICHAR(TO(1:1)) .GE. 16)                               SWALLS     261
     +         .AND. (ICHAR(TO(1:1)) .LE. 25)                          SWALLS     262
     +         .AND. (ICHAR(TO(2:2)) .GE. 16)                          SWALLS     263
     +         .AND. (ICHAR(TO(2:2)) .LE. 25)                          SWALLS     264
     +         .AND. (GETLEN(TO) .EQ. 2)) THEN                         SWALLS     265
              V = VAL (TO)                                             SWALLS     266
              IF ((V .GE. 1) .AND. (V .LE. RMAX)) THEN                 SWALLS     267
                NOK = 1                                                SWALLS     268
              END IF                                                   SWALLS     269
            ENDIF                                                      SWALLS     270
            IF ((LOK .EQ. 1) .AND. ((DOK .EQ. 1) .OR. (NOK .EQ. 1))) THEN  SWALLS  271
              WALL (LINE,3) = TO                                       SWALLS     272
            ELSE                                                       SWALLS     273
              PRINT*                                                   SWALLS     274
              PRINT*, 'INCORRECT ENTRY.  TRY AGAIN!!'                  SWALLS     275
              GOTO 400                                                 SWALLS     276
            END IF                                                     SWALLS     277
            IF(FROM .EQ. TO) THEN                                      SWALLS     278
              PRINT*                                                   SWALLS     279
              PRINT*, 'INCORRECT ENTRY!!'                              SWALLS     280
              PRINT*, '"FROM" CANNOT EQUAL "TO"'                       SWALLS     281
              PRINT*, 'CHECK YOUR DATA AND REENTER "FROM" AND "TO"'    SWALLS     282
              PRINT*                                                   SWALLS     283
              GOTO 300                                                 SWALLS     284
            END IF                                                     SWALLS     285
            IF ((FROM(1:1) .EQ. 'D' ) .AND. (TO(1:1) .EQ. 'D')) THEN   SWALLS     286
              PRINT*                                                   SWALLS     287
              PRINT*,  'INCORRECT ENTRY!!'                             SWALLS     288
              PRINT*, '"FROM" AND "TO" CANNOT BOTH CONTAIN "D"'        SWALLS     289
              PRINT*, '   CHECK YOUR DATA AND REENTER "FROM" AND "TO"' SWALLS     290
              PRINT*                                                   SWALLS     291
              GOTO 300                                                 SWALLS     292
            END IF                                                     SWALLS     293
*         ..................................                           SWALLS     294
 440        PRINT*                                                     SWALLS     295
            PRINT*, 'ENTER HEIGHT, METERS'                             SWALLS     296
            REWIND 1                                                   SWALLS     297
            READ(1,*,END=440) WDIM(LINE,1)                             SWALLS     298
*         ..................................                           SWALLS     299
 460        PRINT*                                                     SWALLS     300
            PRINT*, 'ENTER WIDTH, METERS'                              SWALLS     301
            REWIND 1                                                   SWALLS     302
            READ(1,*,END=460) WDIM(LINE,2)                             SWALLS     303
*         ..................................                           SWALLS     304
 480        PRINT*                                                     SWALLS     305
            PRINT*, 'ENTER THICKNESS OF LAYER, CENTIMETERS'            SWALLS     306
            REWIND 1                                                   SWALLS     307
            READ(1,*,END=480) WDIM(LINE,3)                             SWALLS     308
*         ..................................                           SWALLS     309
 500        PRINT*                                                     SWALLS     310
            PRINT*, 'ENTER "MATERIAL ID" (E.G. ''M01'')'               SWALLS     311
            REWIND 1                                                   SWALLS     312
            READ(1,*,END=500) MAT                                      SWALLS     313
            IF ((GETLEN(MAT).EQ. 3)                                    SWALLS     314
     +         .AND. (MAT(1:1) .EQ. 'M')                               SWALLS     315
     +         .AND. (ICHAR(MAT(2:2)) .GE. 16)                         SWALLS     316
     +         .AND. (ICHAR(MAT(2:2)) .LE. 25)                         SWALLS     317
     +         .AND. (ICHAR(MAT(3:3)) .GE. 16)                         SWALLS     318
     +         .AND. (ICHAR(MAT(3:3)) .LE. 25)) THEN                   SWALLS     319
              WALL(LINE,4) = MAT                                       SWALLS     320
            ELSE                                                       SWALLS     321
```

```
              PRINT*
              PRINT*, 'INCORRECT ENTRY!!  TRY AGAIN'
              GOTO 500
            END IF
          END IF
*         ...................................
          IF (ANSWER .EQ.2) THEN
  580       PRINT*
            PRINT*, 'ENTER THICKNESS OF LAYER, CENTIMETERS'
            REWIND 1
            READ(1,*,END=580) WDIM(LINE,3)
*          ...............................
  600       PRINT*
            PRINT*, 'ENTER "MATERIAL ID" (E.G. ''M01'')'
            REWIND 1
            READ(1,*,END=600) MAT
            IF ((GETLEN(MAT) .EQ. 3)
     +         .AND. (MAT(1:1) .EQ. 'M')
     +         .AND. (ICHAR(MAT(2:2)) .GE. 16)
     +         .AND. (ICHAR(MAT(2:2)) .LE. 25)
     +         .AND. (ICHAR(MAT(3:3)) .GE. 16)
     +         .AND. (ICHAR(MAT(3:3)) .LE. 25)) THEN
              WALL(LINE,4) = MAT
            ELSE
              PRINT*
              PRINT*, 'INCORRECT ENTRY!!    TRY AGAIN'
              GOTO 600
            END IF
            WALL(LINE,3) = WALL(LINE-1,3)
            WALL(LINE,2) = WALL(LINE-1,2)
            WALL(LINE,1) = WALL(LINE-1,1)
            WDIM(LINE,1) = WDIM(LINE-1,1)
            WDIM(LINE,2) = WDIM(LINE-1,2)
          END IF
          RETURN
          END
```

```
--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  ANSWER    1434B                            INTEGER
  DIR       1441B                            CHAR*3
  DOK       1436B                            INTEGER
  FROM      1442B                            CHAR*3
  INSERT       1   DUMMY-ARG                 INTEGER
  LINE         2   DUMMY-ARG                 INTEGER
  LOK       1435B                            INTEGER
  MAT       1444B                            CHAR*3
  NOK       1437B                            INTEGER
  NROOMS    1244B  /ROOMN/                   INTEGER
  RAREA     1245B  /ROOMN/                   REAL            20
  ROOM        0B   /ROOMN/                   REAL           676
  TO        1443B                            CHAR*3
  V         1440B                            INTEGER
  WALL        0B   /WALLC/                   CHAR*3         300
  WDIM        0B   /WALLN/                   REAL           225
  WERR       342B  /WALLN/                   INTEGER
  WTOT       341B  /WALLN/                   INTEGER
```

```
--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE------------------------VALUE

  RMAX    INTEGER                        20
  WMAX    INTEGER                        75


--PROCEDURES--(LO=A)
 -NAME------TYPE--------ARGS------CLASS-----

  GETLEN    INTEGER        1      FUNCTION
  ICHAR     INTEGER        1      INTRINSIC
  VAL       INTEGER        1      FUNCTION


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF       -LABEL-ADDRESS-----PROPERTIES----DEF

     99      7B                    43          460     477B                    171
    100     16B                    47          480     513B                    176
    200     70B                    69          500     527B                    181
    300    127B                    82          580     615B                    200
    400    264B                   116          600     631B                    205
    440    463B                   166


--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  DATAIN      5B     2


--I/O UNITS--(LO=A)
 -NAME--- PROPERTIES-------------

  TAPE1   FMT/SEQ


--STATISTICS--

  PROGRAM-UNIT LENGTH           1447B =  807
  CM LABELLED COMMON LENGTH     1766B =  1014
  CM STORAGE USED              63000B =  26112
  COMPILE TIME                 0.436 SECONDS
```

```
          SUBROUTINE MANIP (QUIT,ABORT)                                          SWALLS      358
*************************************************************************COMW          1
***   COMMON FOR DATABASE OF WALL PARAMETERS                                  ***COMW          2
*************************************************************************COMW          3
          INTEGER WMAX                                                          COMW          4
          PARAMETER (WMAX = 75)                                                 COMW          5
          COMMON /WALLN/ WDIM(WMAX,3), WTOT, WERR                              COMW          6
          COMMON /WALLC/ WALL(WMAX,4)                                           COMW          7
          INTEGER WTOT,WERR                                                     COMW          8
          REAL WDIM                                                             COMW          9
          CHARACTER *3 WALL                                                     COMW         10
* ================================                                              COMW         11
** DESCRIPTION OF ARRAYS                                                        COMW         12
* ================================                                              COMW         13
*    WALL IDENTIFICATION                                                        COMW         14
* --------------------------------                                              COMW         15
* DIRECTION     FROM        TO                                                  COMW         16
*               ROOM        ROOM                                                COMW         17
* --------------------------------                                              COMW         18
* WALL(X,1)   WALL(X,2)   WALL(X,3)                                             COMW         19
*  A3           A3          A3                                                  COMW         20
* ========================================================                      COMW         21
*        WALL PARAMETERS                                                        COMW         22
* --------------------------------------------------------                      COMW         23
* MATERIAL    HEIGHT      WIDTH       LAYER THICKNESS                           COMW         24
* --------------------------------------------------------                      COMW         25
* WALL(X,4)   WDIM(X,1)   WDIM(X,2)   WDIM(X,3)                                 COMW         26
*  A3         F8.2        F8.2        F8.2                                      COMW         27
*************************************************************************COMW         28
*************************************************************************COMW         29
          INTEGER ABORT,ANSWER,DOK,FLAG1,LOK,N,NOK,OK,OK1,OK2,QUIT,INSERT    SWALLS      360
          INTEGER TEMP,V,X,Y,COMMAND                                            SWALLS      361
          CHARACTER * 3 DIR, FROM, TO, MAT                                      SWALLS      362
*                                                                               SWALLS      363
 10       FLAG1 = 0                                                             SWALLS      364
          PRINT*                                                                SWALLS      365
          PRINT*, 'CHOOSE'                                                      SWALLS      366
          PRINT*, '   (1) DISPLAY LINE OF DATA  (4) DISPLAY ALL LINES'          SWALLS      367
          PRINT*, '   (2) INSERT LINE INTO FILE (5) APPEND LINES OF DATA'       SWALLS      368
          PRINT*, '   (3) DELETE LINE           (6) STORE DATA AND EXIT ',      SWALLS      369
     +          'PROGRAM'                                                       SWALLS      370
          PRINT*, '                             (7) EXIT PROGRAM WITHOUT ',     SWALLS      371
     +          'STORING DATA'                                                  SWALLS      372
          PRINT*, 'ENTER A NUMBER !!!'                                          SWALLS      373
          PRINT*                                                                SWALLS      374
          REWIND 1                                                              SWALLS      375
          READ(1,*,END=10) COMMAND                                              SWALLS      376
*                                                                               SWALLS      377
*-----------------------------------------------------------------------        SWALLS      378
*** DISPLAY LINE ***                                                            SWALLS      379
*-----------------------------------------------------------------------        SWALLS      380
          IF ( COMMAND .EQ. 1 ) THEN                                            SWALLS      381
*                                                                               SWALLS      382
*** INDICATE EMPTY DATA FILE                                                    SWALLS      383
             IF ( WTOT .EQ. 0 ) THEN                                            SWALLS      384
                PRINT*                                                          SWALLS      385
                PRINT*, 'DATA FILE IS EMPTY !!!'                                SWALLS      386
*                                                                               SWALLS      387
*** ENTER NUMBER OF LINE TO BE DISPLAYED                                        SWALLS      388
             ELSE                                                               SWALLS      389
 100            PRINT*                                                          SWALLS      390
                PRINT*, 'SPECIFY THE NUMBER OF THE LINE TO BE DISPLAYED'        SWALLS      391
                PRINT*, '     ( ENTER "0" TO ESCAPE DISPLAY MODE )'             SWALLS      392
                REWIND 1                                                        SWALLS      393
```

```
          READ(1,*,END=100) N
*
*** CHECK VALIDITY OF LINE NUMBER
          IF ( (N .GT. WTOT) .OR. (N .LT. 0) ) THEN
            PRINT*
            PRINT*, 'INCORRECT NUMBER !!!!!!       TRY AGAIN !!!'
            PRINT*, '               -OR-  ENTER "0" TO ESCAPE FROM ',
     +               '"DISPLAY" MODE'
            GOTO 100
*
*** ABORT 'DISPLAY' MODE
          ELSE IF ( N .EQ. 0 ) THEN
            PRINT*
            PRINT*, '    "DISPLAY" MODE ABORTED !!!'
*
*** DISPLAY LINE OF DATA
          ELSE IF ( (N .GT. 0) .AND. (N .LE. WTOT) ) THEN
            PRINT*
            CALL DISPLAY( N, COMMAND)
*
          END IF
        END IF
      END IF
*
*-----------------------------------------------------------------------
*** INSERT LINE ***
*-----------------------------------------------------------------------
      IF ( COMMAND .EQ. 2 ) THEN
***************************************************************
*   CHECK TO SEE IF THERE IS ENOUGH ARRAY SPACE
***************************************************************
      IF(WTOT.GE.WMAX) THEN
      WTOT = WMAX
      PRINT *, 'DATA ENTRY ABORTED.'
      PRINT *, 'MAXIMUM NUMBER OF DATA LINES IN FILE WOULD'
      PRINT *, ' HAVE BEEN EXCEEDED. NO MORE THAN ',WMAX
      PRINT *, ' DATA LINES ARE ALLOWED.'
      PRINT *, ' TO INCREASE THE MAXIMUM NUMBER OF ENTRIES ALLOWED,'
      PRINT *, ' CHANGE THE PARAMETER "WMAX" IN EACH COMMON OF'
      PRINT *, ' EVERY SUBROUTINE (THERE ARE FOUR PLACES).'
      PRINT *, ' THEN RECOMPILE THE PROGRAM.'
      GOTO 10
      ENDIF
***************************************************************
*
*** INDICATE EMPTY DATA FILE
        IF ( WTOT .EQ. 0 ) THEN
          PRINT*
          PRINT*, 'DATA FILE IS EMPTY !!!'
*
*** REQUEST NUMBER OF LINE BEFORE WHICH INSERTION IS TO BE MADE
        ELSE
200       PRINT*
          PRINT*, 'SPECIFY NUMBER OF LINE BEFORE WHICH A NEW LINE IS ',
     +            'TO BE INSERTED'
          PRINT*, '     ( ENTER "0" TO ESCAPE "INSERTION" MODE )'
          REWIND 1
          READ(1,*,END=200) N
*
*** CHECK FOR VALID LINE NUMBER
          IF ( ( N .LT. 0 ) .OR. ( N .GT. WTOT ) ) THEN
            PRINT*
            PRINT*, 'INCORRECT NUMBER !!!'
            PRINT*, '      TRY AGAIN !!!  -OR-  ENTER "0" TO ESCAPE',
```

```
     +               '"INSERTION" MODE'
            GOTO 200
*
*** ABORT INSERTION MODE
          ELSE IF ( N .EQ. 0 ) THEN
            PRINT*
            PRINT*, '       "INSERTION" MODE ABORTED'
*
*** MAKE ROOM FOR NEW LINE OF DATA
          ELSE IF ( (N .GT. 0) .AND. (N .LE. WTOT) ) THEN
            DO 230 X = WTOT,N,-1
              DO 210 Y = 1,4
                WALL(X+1,Y) = WALL(X,Y)
210           CONTINUE
              DO 220 Y = 1,3
                WDIM(X+1,Y) = WDIM(X,Y)
220           CONTINUE
230         CONTINUE
*
*** ENTER DATA FOR NEW LINE
            WTOT = WTOT + 1
            CALL DATAIN (1,N)
*
*** INITIALIZE FLAGS
            OK1 = 0
            OK2 = 0
            OK = 0
*
*** TEST VALIDITY OF DATA
*
***TEST IF NEW LAYER BELONGS TO THE NEXT WALL
            IF ( ( WALL(N,1) .EQ. WALL(N+1,1) )
     +           .AND. ( WALL(N,2) .EQ. WALL(N+1,2) )
     +           .AND. ( WALL(N,3) .EQ. WALL(N+1,3) ) ) THEN
              IF ( ( WDIM(N,1) .EQ. WDIM(N+1,1) )
     +             .AND. ( WDIM(N,2) .EQ. WDIM(N+1,2) ) ) THEN
                OK1 = 1
              END IF
            END IF
*
*** TEST IF NEW LAYER BELONGS TO PREVIOUS WALL
            IF ( N .GT. 1 ) THEN
              IF ( ( WALL(N,1) .EQ. WALL(N-1,1) )
     +             .AND. ( WALL(N,2) .EQ. WALL(N-1,2) )
     +             .AND. ( WALL(N,3) .EQ. WALL(N-1,3) ) ) THEN
                IF ( ( WDIM(N,1) .EQ. WDIM(N-1,1) )
     +               .AND. ( WDIM(N,2) .EQ. WDIM(N-1,2) ) ) THEN
                  OK2 = 1
                END IF
              END IF
            END IF
*
            IF ( ( OK1 .EQ. 1 ) .OR. ( OK2 .EQ. 1 ) ) THEN
              OK = 1
            END IF
*
            IF ( OK .EQ. 1 ) THEN
              PRINT*
              PRINT*, 'THE FOLLOWING LINE HAS BEEN ADDED AS LINE ', N
              CALL DISPLAY( N, COMMAND)
*
*** REJECT DATA IF DATA DOESN'T MATCH PREVIOUS OR NEXT LAYER
            ELSE IF ( OK .EQ. 0 ) THEN
              PRINT*
```

```
              PRINT*, 'YOUR DATA WAS NOT ACCEPTED !!!'
              PRINT*, '  YOUR DATA MUST REPRESENT A LAYER ',
     +                'IN AN EXISTING WALL'
              PRINT*, '  I.E.  THE DIRECTION, FROM, TO, HEIGHT, AND ',
     +              'WIDTH'
              PRINT*, '        PARAMETERS MUST MATCH THE WALL JUST ',
     +                'BEFORE'
              PRINT*, '        OR JUST AFTER YOUR SPECIFIED INSERTION ',
     +                'POINT'
              PRINT*
              PRINT*, 'THE FOLLOWING DISPLAYS'
              IF ( N .GT. 1 ) PRINT*,'THE LINE BEFORE YOUR LINE,'
              PRINT*, 'YOUR LINE, AND THE LINE AFTER'
              PRINT*
*
*** DISPLAY LINES OF DATA
              IF ( N .GT. 1 ) CALL DISPLAY ( N-1, COMMAND )
              CALL DISPLAY( N, COMMAND)
              CALL DISPLAY ( N+1, COMMAND)
*
*** REMOVE THE LINE OF INCORRECTLY ENTERED DATA
              DO 270  X = N,WTOT
                DO 250  Y = 1,4
                  WALL(X,Y) = WALL(X+1,Y)
250             CONTINUE
                DO 260  Y = 1,3
                  WDIM(X,Y) = WDIM(X+1,Y)
260             CONTINUE
270           CONTINUE
              WTOT = WTOT - 1
        END IF
      END IF
      END IF
      END IF
*
*-----------------------------------------------------------------------
*** DELETE LINE ***
*-----------------------------------------------------------------------
      IF ( COMMAND .EQ. 3 ) THEN
*
*** INDICATE EMPTY DATA FILE
        IF ( WTOT .EQ. 0 ) THEN
          PRINT*
          PRINT*, 'DATA FILE IS EMPTY !!!'
*
*** READ NUMBER OF LINE TO BE DELETED
        ELSE
300       PRINT*
          PRINT*, 'SPECIFY THE NUMBER OF THE LINE TO BE DELETED'
          PRINT*, '   (ENTER "0" TO ESCAPE DELETION MODE)'
          REWIND 1
          READ(1,*,END=300) N
*
*** CHECK VALIDITY OF LINE NUMBER
          IF ( (N .GT. WTOT ) .OR. ( N .LT. 0 ) ) THEN
            PRINT*
            PRINT*, ' INCORRECT NUMBER !!!'
            PRINT*, '    TRY AGAIN !!!  -OR-  ENTER "0" TO ESCAPE FROM',
     +              '"DELETE" MODE'
            GOTO 300
*
*** ABORT 'DELETE' MODE
          ELSE IF ( N .EQ. 0 ) THEN
            PRINT*, '  "DELETE" MODE ABORTED'
```

```
*                                                                          SWALLS   586
*** DOUBLE CHECK CHOICE OF LINE TO BE DELETED                              SWALLS   587
            ELSE IF (( N .GT. 0 ) .AND. ( N .LE. WTOT )) THEN              SWALLS   588
              PRINT*                                                       SWALLS   589
              PRINT*, 'DOUBLE CHECK !!!'                                   SWALLS   590
              PRINT*, '     DO YOU WANT TO DELETE THE FOLLOWING LINE?:'    SWALLS   591
              CALL DISPLAY( N, COMMAND)                                    SWALLS   592
    305       PRINT*, '   ENTER (1) YES  OR   (2) NO'                      SWALLS   593
              REWIND 1                                                     SWALLS   594
              READ(1,*,END=305) ANSWER                                     SWALLS   595
*                                                                          SWALLS   596
*** DELETE LINE                                                            SWALLS   597
              IF ( ANSWER .EQ. 1 ) THEN                                    SWALLS   598
                DO 330 X = N, WTOT - 1                                     SWALLS   599
                  DO 310 Y = 1,4                                           SWALLS   600
                    WALL(X,Y) = WALL(X+1,Y)                                SWALLS   601
    310           CONTINUE                                                 SWALLS   602
                  DO 320 Y = 1,3                                           SWALLS   603
                    WDIM(X,Y) = WDIM(X+1,Y)                                SWALLS   604
    320           CONTINUE                                                 SWALLS   605
    330         CONTINUE                                                   SWALLS   606
                WTOT = WTOT - 1                                            SWALLS   607
                PRINT*                                                     SWALLS   608
                PRINT*, 'LINE # ',N,' DELETED'                             SWALLS   609
              END IF                                                       SWALLS   610
*                                                                          SWALLS   611
            END IF                                                         SWALLS   612
          END IF                                                           SWALLS   613
        END IF                                                             SWALLS   614
*                                                                          SWALLS   615
*------------------------------------------------------------------------  SWALLS   616
*** DISPLAY ALL DATA ***                                                   SWALLS   617
*------------------------------------------------------------------------  SWALLS   618
        IF ( COMMAND .EQ. 4 ) THEN                                         SWALLS   619
*                                                                          SWALLS   620
*** INDICATE EMPTY DATA FILE                                               SWALLS   621
          IF ( WTOT .EQ. 0 ) THEN                                          SWALLS   622
            PRINT*                                                         SWALLS   623
            PRINT*, 'DATA FILE IS EMPTY !!!'                               SWALLS   624
*                                                                          SWALLS   625
*** DISPLAY DATA                                                           SWALLS   626
          ELSE                                                             SWALLS   627
            PRINT*                                                         SWALLS   628
            CALL DISPLAY( N, COMMAND)                                      SWALLS   629
*                                                                          SWALLS   630
          END IF                                                           SWALLS   631
        END IF                                                             SWALLS   632
*                                                                          SWALLS   633
*------------------------------------------------------------------------  SWALLS   634
*** ADD DATA ***                                                           SWALLS   635
*------------------------------------------------------------------------  SWALLS   636
        IF ( COMMAND .EQ. 5 ) THEN                                         SWALLS   637
*                                                                          SWALLS   638
*** ENTER DATA                                                             SWALLS   639
*****************************************************************          SWALLS   640
*   CHECK TO SEE IF THERE IS ENOUGH ARRAY SPACE                            SWALLS   641
*****************************************************************          SWALLS   642
    500 IF(WTOT.GE.WMAX) THEN                                              SWALLS   643
        WTOT = WMAX                                                        SWALLS   644
        PRINT *, 'DATA ENTRY ABORTED.'                                     SWALLS   645
        PRINT *, 'MAXIMUM NUMBER OF DATA LINES IN FILE WOULD'              SWALLS   646
        PRINT *, ' HAVE BEEN EXCEEDED. NO MORE THAN ',WMAX                 SWALLS   647
        PRINT *, ' DATA LINES ARE ALLOWED.'                                SWALLS   648
        PRINT *, ' TO INCREASE THE MAXIMUM NUMBER OF ENTRIES ALLOWED,'     SWALLS   649
```

```
          PRINT *, ' CHANGE THE PARAMETER "WMAX" IN EACH COMMON OF'
          PRINT *, ' EVERY SUBROUTINE (THERE ARE FOUR PLACES).'
          PRINT *, ' THEN RECOMPILE THE PROGRAM.'
          GOTO 10
          ENDIF
***************************************************************
            WTOT = WTOT + 1
            CALL DATAIN (0,WTOT)
 510        PRINT*
            PRINT*, 'DO YOU WANT TO ENTER MORE DATA?   (1) YES  (2) NO'
            PRINT*, '   ENTER A NUMBER !!!'
            REWIND 1
            READ(1,*,END=510) ANSWER
*
*** CHECK VALIDITY OF NUMBER
            IF ( ( ANSWER .NE. 1 ) .AND. ( ANSWER .NE. 2 ) ) THEN
              GOTO 510
*
*** ENTER MORE DATA
            ELSE IF ( ANSWER .EQ. 1 ) THEN
              GOTO 500
*
*** DISCONTINUE DATA ENTRY
            ELSE IF ( ANSWER .EQ. 2 ) THEN
              PRINT*
              PRINT*, 'DATA ENTRY DISCONTINUED'
*
            END IF
          END IF
*
*----------------------------------------------------------------------
*** STORE DATA AND PROGRAM ***
*----------------------------------------------------------------------
          IF ( COMMAND .EQ. 6 ) THEN
  600       PRINT*
            PRINT*, 'DOUBLE CHECK !!!'
            PRINT*, '    DO YOU YOU WANT TO STORE THIS DATA AND END PROG'
            PRINT*, '  NOTE: STORING THIS DATA WILL WIPE OUT ANY OLD FILE '
            PRINT*, '  OF THE SAME NAME !!!'
            PRINT*, '        ENTER A NUMBER: (1) YES   (2) NO'
            REWIND 1
            READ(1,*,END=600) ANSWER
*
*** SET FLAG FOR STORING DATA IN THE MAIN PROGRAM
            IF ( ANSWER .EQ. 1 ) THEN
              QUIT = 1
              RETURN
*
*** ABORT 'STORING' MODE
            ELSE IF ( ANSWER .EQ. 2 ) THEN
              PRINT*
              PRINT*, '    "STORING" MODE DISCONTINUED'
*
*** CHECK VALIDITY OF ANSWER
            ELSE IF ( ( ANSWER .NE. 1 ) .AND. ( ANSWER .NE. 2 ) ) THEN
              GOTO 600
*
            ENDIF
          ENDIF
*
*----------------------------------------------------------------------
*** END PROGRAM WITHOUT STORING DATA ***
*----------------------------------------------------------------------
          IF ( COMMAND .EQ. 7 ) THEN
```

```
 700    PRINT*
        PRINT*, 'DOUBLE CHECK !!!'
        PRINT*, '    DO YOU WANT TO END THIS PROGRAM ',
     +          'WITHOUT STORING DATA?'
        PRINT*, '          ENTER A NUMBER: (1) YES   (2) NO'
        REWIND 1
        READ(1,*,END=700) ANSWER
*
*** SET FLAG FOR ABORTING PROGRAM IN THE MAIN PROGRAM
        IF ( ANSWER .EQ. 1 ) THEN
          ABORT = 1
          RETURN
*
*** ABORT 'STORING' MODE
        ELSE IF ( ANSWER .EQ. 2 ) THEN
          PRINT*
          PRINT*, '    "ABORTION" MODE DISCONTINUED'
*
*** CHECK VALIDITY OF ANSWER
        ELSE IF ( ( ANSWER .NE. 1 ) .AND. ( ANSWER .NE. 2 ) ) THEN
          GOTO 700
*
        ENDIF
      ENDIF
*
*-----------------------------------------------------------------------
*** LOOP TO BEGINNING OF 'MANIP' SUBROUTINE
*-----------------------------------------------------------------------
      GOTO 10
*
      END
```

```
--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  ABORT        2   DUMMY-ARG                  INTEGER
  ANSWER   2227B                              INTEGER
  COMMAND  2237B                              INTEGER
  DIR      NONE              UNUSED/*S*       CHAR*3
  DOK      NONE              UNUSED/*S*       INTEGER
  FLAG1    2230B                              INTEGER
  FROM     NONE              UNUSED/*S*       CHAR*3
  INSERT   NONE              UNUSED/*S*       INTEGER
  LOK      NONE              UNUSED/*S*       INTEGER
  MAT      NONE              UNUSED/*S*       CHAR*3
  N        2231B                              INTEGER
  NOK      NONE              UNUSED/*S*       INTEGER
  OK       2232B                              INTEGER
  OK1      2233B                              INTEGER
  OK2      2234B                              INTEGER
  QUIT         1   DUMMY-ARG                  INTEGER
  TEMP     NONE              UNUSED/*S*       INTEGER
  TO       NONE              UNUSED/*S*       CHAR*3
  V        NONE              UNUSED/*S*       INTEGER
  WALL        0B  /WALLC/                     CHAR*3        300
  WDIM        0B  /WALLN/                     REAL          225
  WERR      342B  /WALLN/                     INTEGER
  WTOT      341B  /WALLN/                     INTEGER
  X        2235B                              INTEGER
  Y        2236B                              INTEGER
```

```
--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE-----------------------VALUE

  WMAX     INTEGER                       75


--PROCEDURES--(LO=A)
 -NAME------TYPE--------ARGS------CLASS-----

  DATAIN                    2       SUBROUTINE
  DISPLAY                   2       SUBROUTINE


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF        -LABEL-ADDRESS-----PROPERTIES----DEF

    10       7B                    35          300     611B                    240
   100      50B                    61          305     660B                    264
   200     161B                   117          310   INACTIVE   DO-TERM        273
   210   INACTIVE   DO-TERM       142          320   INACTIVE   DO-TERM        276
   220   INACTIVE   DO-TERM       145          330   INACTIVE   DO-TERM        277
   230   INACTIVE   DO-TERM       146          500    1003B                    314
   250   INACTIVE   DO-TERM       217          510    1035B                    329
   260   INACTIVE   DO-TERM       220          600    1076B                    355
   270   INACTIVE   DO-TERM       221          700    1150B                    385


--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  MANIP       5B     2


--I/O UNITS--(LO=A)
 -NAME--- PROPERTIES-------------

  TAPE1   FMT/SEQ


--STATISTICS--

  PROGRAM-UNIT LENGTH          2253B =  1195
  CM LABELLED COMMON LENGTH     475B =  317
  CM STORAGE USED             65000B =  27136
  COMPILE TIME                0.625 SECONDS
```

```
      SUBROUTINE DISPLAY (LINE, COMMAND)                                  SWALLS   745
*************************************************************************COMW       1
***   COMMON FOR DATABASE OF WALL PARAMETERS                          ***COMW       2
*************************************************************************COMW       3
      INTEGER WMAX                                                       COMW       4
      PARAMETER (WMAX = 75)                                              COMW       5
      COMMON /WALLN/ WDIM(WMAX,3), WTOT, WERR                            COMW       6
      COMMON /WALLC/ WALL(WMAX,4)                                        COMW       7
      INTEGER WTOT,WERR                                                  COMW       8
      REAL WDIM                                                          COMW       9
      CHARACTER *3 WALL                                                  COMW      10
* =================================                                      COMW      11
** DESCRIPTION OF ARRAYS                                                 COMW      12
* =================================                                      COMW      13
*    WALL IDENTIFICATION                                                 COMW      14
* ---------------------------------                                      COMW      15
* DIRECTION    FROM       TO                                             COMW      16
*              ROOM       ROOM                                           COMW      17
* ---------------------------------                                      COMW      18
* WALL(X,1)   WALL(X,2)   WALL(X,3)                                      COMW      19
*  A3          A3          A3                                            COMW      20
* =========================================================              COMW      21
*        WALL PARAMETERS                                                 COMW      22
* ---------------------------------------------------------              COMW      23
* MATERIAL    HEIGHT      WIDTH       LAYER THICKNESS                    COMW      24
* ---------------------------------------------------------              COMW      25
* WALL(X,4)   WDIM(X,1)   WDIM(X,2)   WDIM(X,3)                          COMW      26
*  A3         F8.2        F8.2        F8.2                               COMW      27
*************************************************************************COMW      28
*************************************************************************COMW      29
      INTEGER LINE, COMMAND, N                                           SWALLS   747
 1000 FORMAT (8(3X,A))                                                   SWALLS   748
 2000 FORMAT (4X,I3,8X,A3,7X,A3,3X,A3,2X,F6.2,2X,F6.2,5X,F6.2,7X,A3)     SWALLS   749
      PRINT 1000, 'LINE #','DIRECTION','FROM','TO','HEIGHT',             SWALLS   750
     +            'WIDTH','THICKNESS','MATERIAL'                         SWALLS   751
      IF ( COMMAND .EQ  4 ) THEN                                         SWALLS   752
        DO 10 N = 1,WTOT                                                 SWALLS   753
          PRINT 2000, N,WALL(N,1),WALL(N,2),WALL(N,3),WDIM(N,1),         SWALLS   754
     +                WDIM(N,2),WDIM(N,3),WALL(N,4)                      SWALLS   755
 10     CONTINUE                                                         SWALLS   756
      ELSE                                                               SWALLS   757
          PRINT 2000, LINE,WALL(LINE,1),WALL(LINE,2),WALL(LINE,3),       SWALLS   758
     +          WDIM(LINE,1),WDIM(LINE,2),WDIM(LINE,3), WALL(LINE,4)     SWALLS   759
      END IF                                                             SWALLS   760
      RETURN                                                             SWALLS   761
      END                                                                SWALLS   762
```

```
--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  COMMAND      2   DUMMY-ARG                  INTEGER
  LINE         1   DUMMY-ARG                  INTEGER
  N          244B                             INTEGER
  WALL        0B   /WALLC/                    CHAR*3         300
  WDIM        0B   /WALLN/                    REAL           225
  WERR      342B   /WALLN/                    INTEGER
  WTOT      341B   /WALLN/                    INTEGER
```

SUBROUTINE DISPLAY 74/175 OPT=0

```
--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE------------------------VALUE

  WMAX    INTEGER                         75


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

     10  INACTIVE   DO-TERM        40
   1000    150B     FORMAT         32
   2000    152B     FORMAT         33


--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  DISPLAY     5B     2


--STATISTICS--

  PROGRAM-UNIT LENGTH             250B =  168
  CM LABELLED COMMON LENGTH       475B =  317
  CM STORAGE USED               61000B =  25088
  COMPILE TIME                  0.085 SECONDS
```

```
     1        INTEGER FUNCTION VAL(STRING)                    SWALLS     763
     2 C** RETURNS THE INTEGER VALUE OF A STRING.              SWALLS     764
     3        INTEGER NUMBER, X,L,EXP,DIGIT,GETLEN             SWALLS     765
     4        CHARACTER * (*) STRING                           SWALLS     766
     5        L = GETLEN(STRING)                               SWALLS     767
     6        NUMBER = 0                                       SWALLS     768
     7        DO 10 X = L,1,-1                                 SWALLS     769
     8        EXP = L - X                                      SWALLS     770
     9        DIGIT = ICHAR(STRING(X:X)) - 16                  SWALLS     771
    10        NUMBER = NUMBER + DIGIT*10**EXP                  SWALLS     772
    11 10     CONTINUE                                         SWALLS     773
    12        VAL = NUMBER                                     SWALLS     774
    13        RETURN                                           SWALLS     775
    14        END                                              SWALLS     776
```

```
--VARIABLE MAP--(LO=A)
-NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

 DIGIT      76B                               INTEGER
 EXP        75B                               INTEGER
 L          74B                               INTEGER
 NUMBER     72B                               INTEGER
 STRING      1   DUMMY-ARG                    CHAR*(*)
 VAL        71B                               INTEGER
 X          73B                               INTEGER


--PROCEDURES--(LO=A)
-NAME------TYPE--------ARGS------CLASS-----

 GETLEN    INTEGER        1       FUNCTION
 ICHAR     INTEGER        1       INTRINSIC


--STATEMENT LABELS--(LO=A)
-LABEL-ADDRESS-----PROPERTIES----DEF

   10  INACTIVE   DO-TERM        11


--ENTRY POINTS--(LO=A)
-NAME---ADDRESS--ARGS---

 VAL         6B     1


--STATISTICS--

 PROGRAM-UNIT LENGTH             102B =  66
 CM STORAGE USED               61000B =  25088
 COMPILE TIME                  0.039 SECONDS
```

```
      INTEGER FUNCTION GETLEN (STRING)                                 SWALLS   777
C                                                                      SWALLS   778
C DETERMINE LENGTH OF STRING EXCLUDING ANY BLANK PADDING               SWALLS   779
C                                                                      SWALLS   780
C                                                                      SWALLS   781
C ARGUMENT DEFINITIONS --                                              SWALLS   782
C   READ ARGUMENTS                                                     SWALLS   783
C     STRING - STRING WHOSE LENGTH IS TO BE DETERMINED                 SWALLS   784
C                                                                      SWALLS   785
      CHARACTER * (*) STRING                                           SWALLS   786
C                                                                      SWALLS   787
C FUNCTION PARAMETERS                                                  SWALLS   788
      CHARACTER * 1 BLANK                                              SWALLS   789
      PARAMETER (BLANK = ' ')                                          SWALLS   790
C                                                                      SWALLS   791
C LOCAL VARIABLES                                                      SWALLS   792
      INTEGER NEXT                                                     SWALLS   793
C                                                                      SWALLS   794
C START WITH THE LAST CHARACTER AND FIND THE FIRST NON-BLANK           SWALLS   795
      DO 10 NEXT = LEN(STRING),1,-1                                    SWALLS   796
         IF (STRING(NEXT : NEXT) .NE. BLANK) THEN                      SWALLS   797
            GETLEN = NEXT                                              SWALLS   798
            RETURN                                                     SWALLS   799
         ENDIF                                                         SWALLS   800
   10 CONTINUE                                                         SWALLS   801
C                                                                      SWALLS   802
C ALL CHARACTERS ARE BLANKS                                            SWALLS   803
      GETLEN = 0                                                       SWALLS   804
C                                                                      SWALLS   805
      RETURN                                                           SWALLS   806
      END                                                              SWALLS   807
```

```
--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  GETLEN     63B                             INTEGER
  NEXT       64B                             INTEGER
  STRING      1   DUMMY-ARG                  CHAR*(*)


--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE------------------------VALUE

  BLANK   CHAR*1                       ' '


--PROCEDURES--(LO=A)
 -NAME------TYPE--------ARGS------CLASS-----

  LEN       INTEGER        1      INTRINSIC


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

     10  INACTIVE   DO-TERM        25
```

```
  FUNCTION GETLEN   74/175  OPT=0

--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  GETLEN      6B      1


--STATISTICS--

  PROGRAM-UNIT LENGTH              70B =  56
  CM STORAGE USED               61000B =  25088
  COMPILE TIME                  0.037 SECONDS
```

```
      SUBROUTINE LWALL                                                  LWALL     1
*!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!LWALL     2
*!!!                                                                 !!!LWALL     3
*!!!  LOAD THE CONTENTS OF THE FILE 'WALLS' INTO ARRAYS WALL AND WDIM.  LWALL     4
*!!!                                                                 !!!LWALL     5
*!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!LWALL     6
************************************************************************LWALL     7
************************************************************************COMW      1
***   COMMON FOR DATABASE OF WALL PARAMETERS                         ***COMW      2
************************************************************************COMW      3
      INTEGER WMAX                                                      COMW      4
      PARAMETER (WMAX = 75)                                             COMW      5
      COMMON /WALLN/ WDIM(WMAX,3), WTOT, WERR                           COMW      6
      COMMON /WALLC/ WALL(WMAX,4)                                       COMW      7
      INTEGER WTOT,WERR                                                 COMW      8
      REAL WDIM                                                         COMW      9
      CHARACTER *3 WALL                                                 COMW     10
* ==================================                                    COMW     11
** DESCRIPTION OF ARRAYS                                                COMW     12
* ==================================                                    COMW     13
*    WALL IDENTIFICATION                                                COMW     14
* ----------------------------------                                    COMW     15
* DIRECTION     FROM        TO                                          COMW     16
*               ROOM        ROOM                                        COMW     17
* ----------------------------------                                    COMW     18
* WALL(X,1)   WALL(X,2)   WALL(X,3)                                     COMW     19
*  A3           A3          A3                                          COMW     20
* ==========================================================            COMW     21
*        WALL PARAMETERS                                                COMW     22
* ----------------------------------------------------------            COMW     23
* MATERIAL    HEIGHT      WIDTH       LAYER THICKNESS                   COMW     24
* ----------------------------------------------------------            COMW     25
* WALL(X,4)   WDIM(X,1)   WDIM(X,2)   WDIM(X,3)                         COMW     26
*  A3         F8.2        F8.2        F8.2                              COMW     27
************************************************************************COMW     28
************************************************************************COMW     29
************************************************************************COMF      1
*** COMMON FOR INITIAL PARAMETERS                                    ***COMF      2
************************************************************************COMF      3
      INTEGER FMAX                                                      COMF      4
      PARAMETER (FMAX = 50)                                             COMF      5
      COMMON /INITILN/ FREQ, QUALITY, AFLAG, RFLAG, FREQA(FMAX), FERR,  COMF      6
     $                 FTOT                                             COMF      7
      COMMON /INITILC/ BLDG                                             COMF      8
      CHARACTER * 5 BLDG                                                COMF      9
      REAL FREQ, AFLAG, RFLAG, FREQA                                    COMF     10
      INTEGER QUALITY, FERR, FTOT                                       COMF     11
************************************************************************COMF     12
************************************************************************COMF     13
*****************************************************                   LWALL    10
*   DECLARATION OF VARIABLES                                            LWALL    11
*****************************************************                   LWALL    12
      INTEGER GETLEN, R, C                                              LWALL    13
      CHARACTER * 7 NAME, PFN                                           LWALL    14
*****************************************************                   LWALL    15
*                                                                       LWALL    16
*****************************************************                   LWALL    17
      NAME = 'B'//BLDG(1:GETLEN(BLDG))//'W'                             LWALL    18
      PFN = NAME (1:GETLEN(NAME))                                       LWALL    19
      WERR = 0                                                          LWALL    20
      CALL PF  ('GET',0,PFN(1:GETLEN(PFN)),'RC',WERR)                   LWALL    21
      IF ( WERR .EQ. 0 ) THEN                                           LWALL    22
        OPEN (UNIT=3, FILE=PFN, FORM='FORMATTED',                       LWALL    23
     $        STATUS='OLD', ACCESS='SEQUENTIAL')                        LWALL    24
```

```
 1000      FORMAT (1X,4(1X,A3),3(1X,F8.2))                          LWALL        25
           WTOT = 0                                                 LWALL        26
           DO 10 R = 1,WMAX                                         LWALL        27
             READ (3,1000,END=20)(WALL(R,C),C=1,4),(WDIM(R,C),C=1,3)  LWALL      28
             WTOT = WTOT + 1                                        LWALL        29
 10        CONTINUE                                                 LWALL        30
 20        CONTINUE                                                 LWALL        31
           CLOSE(3,STATUS='DELETE')                                 LWALL        32
         ELSE IF ( WERR .EQ. 2 ) THEN                               LWALL        33
           CALL WARNING (7)                                         LWALL        34
         ELSE                                                       LWALL        35
           CALL WARNING (8)                                         LWALL        36
         END IF                                                     LWALL        37
         RETURN                                                     LWALL        38
         END                                                        LWALL        39
```

```
--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  AFLAG       2B   /INITILN/                  REAL
  BLDG        0B   /INITILC/                  CHAR*5
  C         255B                              INTEGER
  FERR       66B   /INITILN/                  INTEGER
  FREQ        0B   /INITILN/                  REAL
  FREQA       4B   /INITILN/                  REAL             50
  FTOT       67B   /INITILN/                  INTEGER
  NAME      256B                              CHAR*7
  PFN       257B                              CHAR*7
  QUALITY     1B   /INITILN/                  INTEGER
  R         254B                              INTEGER
  RFLAG       3B   /INITILN/                  REAL
  WALL        0B   /WALLC/                    CHAR*3          300
  WDIM        0B   /WALLN/                    REAL            225
  WERR      342B   /WALLN/                    INTEGER
  WTOT      341B   /WALLN/                    INTEGER

--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE------------------------VALUE

  FMAX    INTEGER                        50
  WMAX    INTEGER                        75

--PROCEDURES--(LO=A)
 -NAME------TYPE--------ARGS------CLASS-----

  GETLEN    INTEGER        1      FUNCTION
  PF                       5      SUBROUTINE
  WARNING                  1      SUBROUTINE

--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

     10  INACTIVE   DO-TERM        70
     20    117B                    71
   1000    155B     FORMAT         65
```

```
--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  LWALL       5B     0


--I/O UNITS--(LO=A)
 -NAME--- PROPERTIES-------------

  TAPE3   AUX/FMT/SEQ


--STATISTICS--

  PROGRAM-UNIT LENGTH              265B =  181
  CM LABELLED COMMON LENGTH        566B =  374
  CM STORAGE USED                63000B =  26112
  COMPILE TIME                   0.105 SECONDS
```

```
  1        SUBROUTINE WARNING(ERR)                                        WARNING      1
  2        INTEGER ERR, ERRM                                              WARNING      2
  3        CHARACTER*45 MESSAGE(20)                                       WARNING      3
  4        DATA MESSAGE( 1)/'"HOLE" DATA FILE DOES NOT EXIST FOR THIS BLDG'/ WARNING   4
  5        DATA MESSAGE( 2)/'FILE HANDLING PROBLEM ON "HOLE" DATA FILE    '/ WARNING   5
  6        DATA MESSAGE( 3)/'"MATTER" FILE DOES NOT EXIST FOR THIS BLDG   '/ WARNING   6
  7        DATA MESSAGE( 4)/'FILE HANDLING PROBLEM ON "MATTER FILE        '/ WARNING   7
  8        DATA MESSAGE( 5)/'"TYPE" DATA FILE DOES NOT EXIST FOR THIS BLDG'/ WARNING   8
  9        DATA MESSAGE( 6)/'FILE HANDLING PROBLEM ON "TYPE" FILE         '/ WARNING   9
 10        DATA MESSAGE( 7)/'"WALL" DATA FILE DOES NOT EXIST FOR THIS BLDG'/ WARNING  10
 11        DATA MESSAGE( 8)/'FILE HANDLING PROBLEM ON "WALL" FILE         '/ WARNING  11
 12        DATA MESSAGE( 9)/'HEIGHT AND WIDTH OF ROOM MISSING             '/ WARNING  12
 13        DATA MESSAGE(10)/'LENGTH OF ROOM IS MISSING                    '/ WARNING  13
 14        DATA MESSAGE(11)/'FREQ FILE DOES NOT EXIST FOR THIS BLDG       '/ WARNING  14
 15        DATA MESSAGE(12)/'FILE HANDLING PROBLEM WITH FREQ FILE         '/ WARNING  15
 16        DATA MESSAGE(13)/'WARNING CODE IS OUT OF RANGE                 '/ WARNING  16
 17        DATA MESSAGE(14)/'WARNING CODE IS OUT OF RANGE                 '/ WARNING  17
 18        DATA MESSAGE(15)/'WARNING CODE IS OUT OF RANGE                 '/ WARNING  18
 19        DATA MESSAGE(16)/'WARNING CODE IS OUT OF RANGE                 '/ WARNING  19
 20        DATA MESSAGE(17)/'WARNING CODE IS OUT OF RANGE                 '/ WARNING  20
 21        DATA MESSAGE(18)/'WARNING CODE IS OUT OF RANGE                 '/ WARNING  21
 22        DATA MESSAGE(19)/'WARNING CODE IS OUT OF RANGE                 '/ WARNING  22
 23        DATA MESSAGE(20)/'WARNING CODE IS OUT OF RANGE                 '/ WARNING  23
 24        ERRM=12                                                        WARNING     24
 25        IERR = ERR                                                     WARNING     25
 26        IF(ERR.GT.ERRM) IERR=20                                        WARNING     26
 27        WRITE(6,20)                                                    WARNING     27
 28        WRITE(6,10) ERR,MESSAGE(IERR)                                  WARNING     28
 29        WRITE(6,20)                                                    WARNING     29
 30 10     FORMAT(' ***WARNING NUMBER = ',I5,' ***  ',A45)                WARNING     30
 31 20     FORMAT('      ')                                               WARNING     31
 32        RETURN                                                         WARNING     32
 33        END                                                            WARNING     33
```

```
--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  ERR          1   DUMMY-ARG                 INTEGER
  ERRM       60B                             INTEGER
  IERR      213B                             INTEGER
  MESSAGE    61B                             CHAR*45        20


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

    10      34B     FORMAT         30
    20      42B     FORMAT         31


--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  WARNING     5B     1
```



```
--I/O UNITS--(LO=A)
 -NAME--- PROPERTIES-------------

  TAPE6   FMT/SEQ


--STATISTICS--

  PROGRAM-UNIT LENGTH            216B =   142
  CM STORAGE USED              61000B = 25088
  COMPILE TIME                 0.060 SECONDS
```

```
      SUBROUTINE ERROR(IERR)                                          ERROR      1
      CHARACTER*45 MESSAGE(20)                                        ERROR      2
      DATA MESSAGE( 1)/'MATERIALS DATA BASE IS EMPTY               '/ ERROR      3
      DATA MESSAGE( 2)/'FREQUENCY IS OUT OF RANGE                  '/ ERROR      4
      DATA MESSAGE( 3)/'THIS MATERIAL IS NOT IN DATA BASE          '/ ERROR      5
      DATA MESSAGE( 4)/'DENOMINATOR IS ZERO                        '/ ERROR      6
      DATA MESSAGE( 5)/'FILE HANDLING ERROR                        '/ ERROR      7
      DATA MESSAGE( 6)/'ERROR CODE IS OUT OF RANGE                 '/ ERROR      8
      DATA MESSAGE( 7)/'ERROR CODE IS OUT OF RANGE                 '/ ERROR      9
      DATA MESSAGE( 8)/'ERROR CODE IS OUT OF RANGE                 '/ ERROR     10
      DATA MESSAGE( 9)/'ERROR CODE IS OUT OF RANGE                 '/ ERROR     11
      DATA MESSAGE(10)/'ERROR CODE IS OUT OF RANGE                 '/ ERROR     12
      DATA MESSAGE(11)/'ERROR CODE IS OUT OF RANGE                 '/ ERROR     13
      DATA MESSAGE(12)/'ERROR CODE IS OUT OF RANGE                 '/ ERROR     14
      DATA MESSAGE(13)/'ERROR CODE IS OUT OF RANGE                 '/ ERROR     15
      DATA MESSAGE(14)/'ERROR CODE IS OUT OF RANGE                 '/ ERROR     16
      DATA MESSAGE(15)/'ERROR CODE IS OUT OF RANGE                 '/ ERROR     17
      DATA MESSAGE(16)/'ERROR CODE IS OUT OF RANGE                 '/ ERROR     18
      DATA MESSAGE(17)/'ERROR CODE IS OUT OF RANGE                 '/ ERROR     19
      DATA MESSAGE(18)/'ERROR CODE IS OUT OF RANGE                 '/ ERROR     20
      DATA MESSAGE(19)/'ERROR CODE IS OUT OF RANGE                 '/ ERROR     21
      DATA MESSAGE(20)/'ERROR CODE IS OUT OF RANGE                 '/ ERROR     22
      IERRM=5                                                         ERROR     23
      IF(IERR.GT.IERRM) IERR=20                                       ERROR     24
      WRITE(6,10) IERR,MESSAGE(IERR)                                  ERROR     25
 10   FORMAT(' ***ERROR NUMBER = ',I5,' ***  ',A45)                   ERROR     26
      CALL PMDSTOP                                                    ERROR     27
      STOP 'ERROR'                                                    ERROR     28
      END                                                             ERROR     29
```

```
--VARIABLE MAP--(LO=A)
-NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

 IERR        1   DUMMY-ARG                  INTEGER
 IERRM     210B                             INTEGER
 MESSAGE    56B                             CHAR*45        20


--PROCEDURES--(LO=A)
-NAME------TYPE--------ARGS------CLASS-----

 PMDSTOP                  0      SUBROUTINE


--STATEMENT LABELS--(LO=A)
-LABEL-ADDRESS-----PROPERTIES----DEF

   10      36B     FORMAT          26


--ENTRY POINTS--(LO=A)
-NAME---ADDRESS--ARGS---

 ERROR       5B     1
```



```
--I/O UNITS--(LO=A)
-NAME--- PROPERTIES------------

 TAPE6   FMT/SEQ


--STATISTICS--

 PROGRAM-UNIT LENGTH               213B =  139
 CM STORAGE USED                 61000B =  25088
 COMPILE TIME                    0.056 SECONDS
```

Appendix 9.5 Listing of Computer Program STYPES

```
       PROGRAM STYPES (INPUT,TAPE1=INPUT)                               STYPES     1
*                                                                       STYPES     2
*THIS INTERACTIVE PROGRAM INPUTS THE DATA DESCRIBING EACH TYPE          STYPES     3
*IN THE BUILDING AND STORES IT.  THE FILE NAME IS CREATED BY            STYPES     4
*ATTACHING "B" TO THE FRONT OF AND "W" TO THE BACK OF THE BUILDING      STYPES     5
*IDENTIFICATION. THE BUILDING IDENTIFICATION CAN BE NO MORE             STYPES     6
*THAN 5 ALPHANUMERIC CHARACTERS.                                        STYPES     7
                                                                        STYPES     8
************************************************************************COMF       1
*** COMMON FOR INITIAL PARAMETERS                                    ***COMF       2
************************************************************************COMF       3
      INTEGER FMAX                                                      COMF       4
      PARAMETER (FMAX = 50)                                             COMF       5
      COMMON /INITILN/ FREQ, QUALITY, AFLAG, RFLAG, FREQA(FMAX), FERR,  COMF       6
     $                 FTOT                                             COMF       7
      COMMON /INITILC/ BLDG                                             COMF       8
      CHARACTER * 5 BLDG                                                COMF       9
      REAL FREQ, AFLAG, RFLAG, FREQA                                    COMF      10
      INTEGER QUALITY, FERR, FTOT                                       COMF      11
************************************************************************COMF      12
************************************************************************COMF      13
************************************************************************COMR       1
***   COMMON FOR ROOM ARRAY CONTAINING ATTENUATION OF WALLS          ***COMR       2
************************************************************************COMR       3
      INTEGER RMAX                                                      COMR       4
      PARAMETER (RMAX = 20)                                             COMR       5
      COMMON /ROOMN/ ROOM(RMAX + 6, RMAX + 6), NROOMS, RAREA(RMAX)      COMR       6
      INTEGER NROOMS                                                    COMR       7
      REAL ROOM                                                         COMR       8
************************************************************************COMR       9
************************************************************************COMR      10
************************************************************************COMT       1
***   COMMON FOR DATABASE OF TYPES OF DOORS AND WINDOWS              ***COMT       2
************************************************************************COMT       3
      INTEGER TMAX                                                      COMT       4
      PARAMETER (TMAX=35)                                               COMT       5
      COMMON /TYPEN/TDIM(TMAX,4),TTOT,TDB2(TMAX,2),TDBTOT,TERR          COMT       6
      COMMON /TYPEC/TYPE(TMAX,3),TDB1(TMAX)                             COMT       7
      INTEGER TTOT,TDBTOT,TERR                                          COMT       8
      REAL TDIM,TDB2                                                    COMT       9
      CHARACTER * 3 TYPE,TDB1                                           COMT      10
*=================================================                      COMT      11
* DESCRIPTION OF ARRAYS                                                 COMT      12
*=================================================                      COMT      13
*   ID        MATERIAL    FRAME MATERIAL                                COMT      14
*-------------------------------------------------                      COMT      15
*TYPE(X,1)   TYPE(X,2)   TYPE(X,3)                                      COMT      16
* A3          A3          A3                                            COMT      17
*=================================================                      COMT      18
* HEIGHT      WIDTH       LAYER       DISTANCE                          COMT      19
*                         THICKNESS   ABOVE FLOOR                       COMT      20
*-------------------------------------------------                      COMT      21
* TDIM(X,1)   TDIM(X,2)   TDIM(X,3)   TDIM(X,4)                         COMT      22
*  F8.2        F8.2        F8.2        F8.2                             COMT      23
*=================================================                      COMT      24
*  ID       ATTENUATION    AREA                                         COMT      25
* ------------------------------------------------                      COMT      26
* TDB1(X)    TDB2(X,1)    TDB2(X,2)                                     COMT      27
*   A3          E9.3         E9.3                                       COMT      28
************************************************************************COMT      29
************************************************************************COMT      30
      INTEGER GETLEN,QUIT,ABORT,ANSWER,OLDFILE,N,Y1,Y2,LINE             STYPES    12
      INTEGER IERR                                                      STYPES    13
      CHARACTER * 7  PFN                                                STYPES    14
```

```
*
* INITIALIZATION
      QUIT = 0
      TTOT = 0
      ABORT = 0
100   PRINT*
      PRINT *, 'ENTER BUILDING IDENTIFICATION  (E.G. ''101'')'
      PRINT *, '    (NO MORE THAN 5 ALPHANUMERIC CHARACTERS)'
      REWIND 1
      READ(1,*,END=100) BLDG

      IF ( GETLEN(BLDG) .GT. 5 ) THEN
        GO TO 100
      END IF
      PFN = 'B' // BLDG(1:GETLEN(BLDG)) // 'T'
*
*** LOAD DATA ID EXISTING FILE IF NECESSARY
200   PRINT*
      PRINT*,'WILL THIS BE'
      PRINT*,'   (1) A MODIFICATION OF AN EXISTING FILE?'
      PRINT*,'   (2) A NEW FILE?'
      PRINT*,'ENTER A NUMBER  !!!'
      REWIND 1
      READ(1,*,END=200) OLDFILE
      IF ( ( OLDFILE .NE. 1 ) .AND. ( OLDFILE .NE. 2 ) ) THEN
        GOTO 200
      ELSE IF ( OLDFILE .EQ. 1 ) THEN
*
*** CHECK FOR EXISTENCE OF PERMANENT FILE OF SAME NAME
        IERR = 0
        CALL PF ('GET',0,PFN(1:GETLEN(PFN)),'RC',IERR)
        IF ( IERR .EQ. 2 ) THEN
          PRINT*
          PRINT *, 'FILE ',PFN, ' NOT FOUND'
          PRINT*, 'PROGRAM ABORTED!!!'
          PRINT*
          PRINT*, 'FIND CORRECT BUILDING IDENTIFIER AND RESTART ',
     +              'PROGRAM'
          PRINT*
          STOP
*
        ELSE
          CALL LTYPE
          IF (TERR .NE. 0) CALL ERROR(5)
        END IF
      ELSE IF ( OLDFILE .EQ. 2 ) THEN
*
*** CHECK FOR EXISTENCE OF PERMANENT FILE OF SAME NAME
        IERR = 0
        CALL PF ('GET',0,PFN(1:GETLEN(PFN)),'RC',IERR)
        IF ( IERR .EQ. 0 ) THEN
          PRINT*
          PRINT*, 'DATA FILE ALREADY EXISTS FOR BUILDING ',BLDG
          PRINT*
          PRINT*,'IF YOU ENTER DATA AND STORE IT, YOU WILL WRITE ',
     +             'OVER THE OLD FILE.'
250       PRINT*
          PRINT*,'YOU MAY EITHER (1) ABORT OR (2) CONTINUE.'
          PRINT*,'INDICATE YOUR CHOICE BY ENTERING A NUMBER.'
          REWIND 1
          READ(1,*,END=250) ANSWER
            PRINT*
            PRINT*,'PROGRAM HAS BEEN ABORTED, PER YOUR REQUEST'
            PRINT*
```

```
            IF ( ANSWER .EQ. 1 ) THEN
              STOP
            ELSE IF ( ANSWER .EQ. 2 ) THEN
  255         CONTINUE
            ELSE
              GOTO 250
            END IF
          ELSE IF ( IERR .EQ. 2 ) THEN
*
*           NO DATA FILE EXISTS FOR THIS BUILDING AND DATA ENTRY
*           CAN CONTINUE
*
  260       CONTINUE
          ELSE
*
*           **PERMANENT FILE ERROR
*
            PRINT*
            PRINT*,'PROGRAM ABORTED !!!'
            PRINT*,'  SOME PERMANENT FILE ERROR HAS OCCURRED'
            PRINT*,'  DOUBLE CHECK YOUR BUILDING IDENTIFICATION ',
     +           'AND TRY AGAIN'
            STOP
          END IF
          PRINT*
          PRINT*, ' BEGIN ENTERING DATA'
  300     TTOT = TTOT + 1
          IF ( TTOT .EQ. 1) THEN
            CALL DATAIN(1,TTOT)
          ELSE
            CALL DATAIN (0,TTOT)
          END IF
  400     PRINT*
          PRINT*, 'DO YOU WANT TO ENTER MORE DATA?',
     +           '(1) YES  (2) NO'
          PRINT*, '  ENTER A NUMBEER !!!'
          REWIND 1
          READ(1,*,END=400) ANSWER
          IF ( (ANSWER .NE. 1) .AND. (ANSWER .NE. 2) ) THEN
            GOTO 400
          ELSE IF ( ANSWER .EQ. 1) THEN
            GOTO 300
          ELSE IF ( ANSWER .EQ. 2 ) THEN
            PRINT*
            PRINT*, 'DATA ENTRY DISCONTINUED'
          END IF
        END IF
*
*** MANIPULATE DATA
        CALL MANIP (QUIT,ABORT)
*
*** TERMINATE PROGRAM, STORING DATA IF NECESSARY
        IF ( QUIT .EQ. 1 ) THEN
         OPEN(UNIT=6,FILE=PFN(1:GETLEN(PFN)),FORM='FORMATTED',
     +          ACCESS='SEQUENTIAL',STATUS='NEW')
  500     FORMAT (1X,3(1X,A3),4(1X,F8.2))
          DO 600 N = 1,TTOT
            WRITE (6,500)(TYPE(N,Y1), Y1=1,3),(TDIM(N,Y2), Y2=1,4)
  600     CONTINUE
          ENDFILE(6)
          CALL PF ('REPLACE',0,PFN(1:GETLEN(PFN)))
WARNING* NUMBER OF ARGUMENTS IN REFERENCE TO _PF IS NOT CONSISTENT
          CLOSE(6,STATUS='DELETE')
          PRINT*
```

```
          PRINT*,'DATA HAS BEEN STORED AND PROGRAM TERMINATED'               STYPES     142
        END IF                                                               STYPES     143
        IF( ABORT .EQ. 1 ) THEN                                              STYPES     144
          PRINT*                                                             STYPES     145
          PRINT*, 'PROGRAM HAS BEEN ABORTED'                                 STYPES     146
          PRINT*,'      NO DATA HAS BEEN STORED !!!'                         STYPES     147
        END IF                                                               STYPES     148
        STOP                                                                 STYPES     149
        END                                                                  STYPES     150
```

```
--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  ABORT    1077B                             INTEGER
  AFLAG       2B  /INITILN/                  REAL
  ANSWER   1100B                             INTEGER
  BLDG        0B  /INITILC/                  CHAR*5
  FERR       66B  /INITILN/                  INTEGER
  FREQ        0B  /INITILN/                  REAL
  FREQA       4B  /INITILN/                  REAL             50
  FTOT       67B  /INITILN/                  INTEGER
  IERR     1105B                             INTEGER
  LINE     NONE              UNUSED/*S*      INTEGER
  N        1102B                             INTEGER
  NROOMS   1244B  /ROOMN/                    INTEGER
  OLDFILE  1101B                             INTEGER
  PFN      1106B                             CHAR*7
  QUALITY     1B  /INITILN/                  INTEGER
  QUIT     1076B                             INTEGER
  RAREA    1245B  /ROOMN/                    REAL             20
  RFLAG       3B  /INITILN/                  REAL
  ROOM        0B  /ROOMN/                    REAL            676
  TDBTOT    323B  /TYPEN/                    INTEGER
  TDB1       37B  /TYPEC/                    CHAR*3           35
  TDB2      215B  /TYPEN/                    REAL             70
  TDIM        0B  /TYPEN/                    REAL            140
  TERR      324B  /TYPEN/                    INTEGER
  TTOT      214B  /TYPEN/                    INTEGER
  TYPE        0B  /TYPEC/                    CHAR*3          105
  Y1       1103B                             INTEGER
  Y2       1104B                             INTEGER


--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE------------------------VALUE

  FMAX    INTEGER                        50
  RMAX    INTEGER                        20
  TMAX    INTEGER                        35


--PROCEDURES--(LO=A)
 -NAME------TYPE--------ARGS------CLASS-----      -NAME------TYPE--------ARGS------CLASS-----

  DATAIN                   2      SUBROUTINE       LTYPE                      0      SUBROUTINE
  ERROR                    1      SUBROUTINE       MANIP                      2      SUBROUTINE
  GETLEN    INTEGER        1      FUNCTION         PF                         5      SUBROUTINE
```

```
--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF        -LABEL-ADDRESS-----PROPERTIES----DEF

    100     21B                     70           300    246B                     155
    200     47B                     82           400    260B                     161
    250    166B                    121           500    626B      FORMAT         184
    255 *NO REFS*                  132           600  INACTIVE    DO-TERM        187
    260 *NO REFS*                  141


--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  STYPES     14B     0


--I/O UNITS--(LO=A)
 -NAME--- PROPERTIES-------------

  TAPE1   FMT/SEQ
  TAPE6   AUX/FMT/SEQ


--STATISTICS--

  PROGRAM-UNIT LENGTH           1112B =  586
  CM LABELLED COMMON LENGTH     1761B =  1009
  CM STORAGE USED              63000B =  26112
  COMPILE TIME                 0.287 SECONDS

       1  WARNING   ERROR IN  STYPES
```

```
      SUBROUTINE DATAIN (INSERT,LINE)                                   STYPES   151
************************************************************************COMR       1
***   COMMON FOR ROOM ARRAY CONTAINING ATTENUATION OF WALLS          ***COMR       2
************************************************************************COMR       3
      INTEGER RMAX                                                      COMR       4
      PARAMETER (RMAX = 20)                                             COMR       5
      COMMON /ROOMN/ ROOM(RMAX + 6, RMAX + 6), NROOMS, RAREA(RMAX)      COMR       6
      INTEGER NROOMS                                                    COMR       7
      REAL ROOM                                                         COMR       8
************************************************************************COMR       9
************************************************************************COMR      10
************************************************************************COMT       1
***   COMMON FOR DATABASE OF TYPES OF DOORS AND WINDOWS              ***COMT       2
************************************************************************COMT       3
      INTEGER TMAX                                                      COMT       4
      PARAMETER (TMAX=35)                                               COMT       5
      COMMON /TYPEN/TDIM(TMAX,4),TTOT,TDB2(TMAX,2),TDBTOT,TERR          COMT       6
      COMMON /TYPEC/TYPE(TMAX,3),TDB1(TMAX)                             COMT       7
      INTEGER TTOT,TDBTOT,TERR                                          COMT       8
      REAL TDIM,TDB2                                                    COMT       9
      CHARACTER * 3 TYPE,TDB1                                           COMT      10
*=================================================                      COMT      11
* DESCRIPTION OF ARRAYS                                                 COMT      12
*=================================================                      COMT      13
*   ID        MATERIAL    FRAME MATERIAL                                COMT      14
*-------------------------------------------------                      COMT      15
*TYPE(X,1)   TYPE(X,2)   TYPE(X,3)                                      COMT      16
* A3          A3          A3                                            COMT      17
*=================================================                      COMT      18
* HEIGHT      WIDTH       LAYER       DISTANCE                          COMT      19
*                         THICKNESS   ABOVE FLOOR                       COMT      20
*-------------------------------------------------                      COMT      21
* TDIM(X,1)   TDIM(X,2)   TDIM(X,3)   TDIM(X,4)                         COMT      22
*  F8.2        F8.2        F8.2        F8.2                             COMT      23
*=================================================                      COMT      24
*  ID      ATTENUATION    AREA                                          COMT      25
* -----------------------------------------------                       COMT      26
* TDB1(X)    TDB2(X,1)    TDB2(X,2)                                     COMT      27
*   A3          E9.3         E9.3                                       COMT      28
************************************************************************COMT      29
************************************************************************COMT      30
        INTEGER  ANSWER,LOK,DOK,NOK,GETLEN,VAL, INSERT,LINE,V           STYPES   154
        REAL H,W,T,ABOVE                                                STYPES   155
        CHARACTER *3 DIR,ID,MAT,FMAT                                    STYPES   156
   99   IF ( INSERT .EQ. 1 ) THEN                                       STYPES   157
          ANSWER = 1                                                    STYPES   158
          INSERT = 1                                                    STYPES   159
        ELSE                                                            STYPES   160
100       PRINT*                                                        STYPES   161
          PRINT*, 'IS THIS THE FIRST LAYER OF A DOOR OR WINDOW?',       STYPES   162
     +              '  (1) YES (2) NO'                                  STYPES   163
          PRINT*, '      ENTER "0" TO ESCAPE "DATA ENTRY" MODE'         STYPES   164
          PRINT*, ' ENTER A NUMBER!!'                                   STYPES   165
          REWIND 1                                                      STYPES   166
          READ(1,*,END=100) ANSWER                                      STYPES   167
        END IF                                                          STYPES   168
*                                                                       STYPES   169
        IF (ANSWER .EQ. 0)  THEN                                        STYPES   170
          TTOT = TTOT - 1                                               STYPES   171
          PRINT*                                                        STYPES   172
          PRINT*, 'DATA ENTRY MODE ABORTED'                             STYPES   173
        END IF                                                          STYPES   174
*                                                                       STYPES   175
        IF ((ANSWER .NE. 2)                                             STYPES   176
```

```
         +     .AND. (ANSWER .NE. 1)                                  STYPES   177
         +     .AND. (ANSWER .NE. 0)) THEN                            STYPES   178
               PRINT*                                                 STYPES   179
               PRINT*, 'INCORRECT NUMBER!!'                           STYPES   180
               PRINT*, ' TRY AGAIN!! -OR- ENTER "0" TO ESCAPE DATA ENTRY MODE'STYPES   181
               GOTO 99                                                STYPES   182
             END IF                                                   STYPES   183
      *                                                               STYPES   184
      *      .................................                        STYPES   185
           IF ( ANSWER .EQ. 1 ) THEN                                  STYPES   186
       300   PRINT*                                                   STYPES   187
             PRINT*, 'ENTER ''ID'' (E.G. ''WA'' OR ''DE'')'           STYPES   188
             REWIND 1                                                 STYPES   189
             READ(1,*,END=300) ID                                     STYPES   190
             IF (((ICHAR(ID(1:1)) .EQ. 55)                            STYPES   191
         +     .OR. (ICHAR(ID(1:1)) .EQ. 36))                         STYPES   192
         +     .AND. (ICHAR(ID(2:2)) .GE. 33)                         STYPES   193
         +     .AND. (ICHAR(ID(2:2)) .LE. 58)                         STYPES   194
         +     .AND. (GETLEN(ID) .EQ. 2)) THEN                        STYPES   195
               TYPE(LINE,1) = ID                                      STYPES   196
             ELSE                                                     STYPES   197
               PRINT*                                                 STYPES   198
               PRINT*, 'INCORRECT ENTRY.  TRY AGAIN!!'                STYPES   199
               GOTO 300                                               STYPES   200
             END IF                                                   STYPES   201
      *      ............................                             STYPES   202
       440     PRINT*                                                 STYPES   203
               PRINT*, 'ENTER HEIGHT, METERS'                         STYPES   204
               REWIND 1                                               STYPES   205
               READ(1,*,END=440) TDIM(LINE,1)                         STYPES   206
      *      ................................                         STYPES   207
       460     PRINT*                                                 STYPES   208
               PRINT*, 'ENTER WIDTH, METERS'                          STYPES   209
               REWIND 1                                               STYPES   210
               READ(1,*,END=460) TDIM(LINE,2)                         STYPES   211
      *      ...............................                          STYPES   212
       470     PRINT*                                                 STYPES   213
               PRINT*, 'ENTER DISTANCE ABOVE FLOOR, METERS'           STYPES   214
               REWIND 1                                               STYPES   215
               READ(1,*,END=470) TDIM(LINE,4)                         STYPES   216
      *      ...............................                          STYPES   217
       480     PRINT*                                                 STYPES   218
               PRINT*, 'ENTER THICKNESS OF LAYER, CENTIMETERS'        STYPES   219
               REWIND 1                                               STYPES   220
               READ(1,*,END=480) TDIM(LINE,3)                         STYPES   221
      *      ...............................                          STYPES   222
       500     PRINT*                                                 STYPES   223
               PRINT*, 'ENTER "MATERIAL ID OF LAYER" (E.G. ''M01'')'  STYPES   224
               REWIND 1                                               STYPES   225
               READ(1,*,END=500) MAT                                  STYPES   226
               IF ((GETLEN(MAT).EQ. 3)                                STYPES   227
         +       .AND. (MAT(1:1) .EQ. 'M')                            STYPES   228
         +       .AND. (ICHAR(MAT(2:2)) .GE. 16)                      STYPES   229
         +       .AND. (ICHAR(MAT(2:2)) .LE. 25)                      STYPES   230
         +       .AND. (ICHAR(MAT(3:3)) .GE. 16)                      STYPES   231
         +       .AND. (ICHAR(MAT(3:3)) .LE. 25)) THEN                STYPES   232
                 TYPE(LINE,2) = MAT                                   STYPES   233
               ELSE                                                   STYPES   234
                 PRINT*                                               STYPES   235
                 PRINT*, 'INCORRECT ENTRY!!  TRY AGAIN'               STYPES   236
                 GOTO 500                                             STYPES   237
               END IF                                                 STYPES   238
      *      ...............................                          STYPES   239
       510     PRINT*                                                 STYPES   240
```

```
            PRINT*, 'ENTER "MATERIAL ID OF FRAME" (E.G. ''M01'')'        STYPES     241
            REWIND 1                                                     STYPES     242
            READ(1,*,END=510) FMAT                                       STYPES     243
            IF ((GETLEN(FMAT).EQ. 3)                                     STYPES     244
     +         .AND. (FMAT(1:1) .EQ. 'M')                                STYPES     245
     +         .AND. (ICHAR(FMAT(2:2)) .GE. 16)                          STYPES     246
     +         .AND. (ICHAR(FMAT(2:2)) .LE. 25)                          STYPES     247
     +         .AND. (ICHAR(FMAT(3:3)) .GE. 16)                          STYPES     248
     +         .AND. (ICHAR(FMAT(3:3)) .LE. 25)) THEN                    STYPES     249
              TYPE(LINE,3) = FMAT                                        STYPES     250
            ELSE                                                         STYPES     251
              PRINT*                                                     STYPES     252
              PRINT*, 'INCORRECT ENTRY!!  TRY AGAIN'                     STYPES     253
              GOTO 510                                                   STYPES     254
            END IF                                                       STYPES     255
          END IF                                                         STYPES     256
*                                                                        STYPES     257
*         ...................................                            STYPES     258
*                                                                        STYPES     259
          IF (ANSWER .EQ.2) THEN                                         STYPES     260
  580       PRINT*                                                       STYPES     261
            PRINT*, 'ENTER THICKNESS OF LAYER, CENTIMETERS'              STYPES     262
            REWIND 1                                                     STYPES     263
            READ(1,*,END=580) TDIM(LINE,3)                               STYPES     264
*           ..............................                               STYPES     265
  600       PRINT*                                                       STYPES     266
            PRINT*, 'ENTER "MATERIAL ID OF LAYER" (E.G. ''M01'')'        STYPES     267
            REWIND 1                                                     STYPES     268
            READ(1,*,END=600) MAT                                        STYPES     269
            IF ((GETLEN(MAT) .EQ. 3)                                     STYPES     270
     +         .AND. (MAT(1:1) .EQ. 'M')                                 STYPES     271
     +         .AND. (ICHAR(MAT(2:2)) .GE. 16)                           STYPES     272
     +         .AND. (ICHAR(MAT(2:2)) .LE. 25)                           STYPES     273
     +         .AND. (ICHAR(MAT(3:3)) .GE. 16)                           STYPES     274
     +         .AND. (ICHAR(MAT(3:3)) .LE. 25)) THEN                     STYPES     275
              TYPE(LINE,2) = MAT                                         STYPES     276
            ELSE                                                         STYPES     277
              PRINT*                                                     STYPES     278
              PRINT*, 'INCORRECT ENTRY!!    TRY AGAIN'                   STYPES     279
              GOTO 600                                                   STYPES     280
            END IF                                                       STYPES     281
            TYPE(LINE,3) = TYPE(LINE-1,3)                                STYPES     282
            TYPE(LINE,1) = TYPE(LINE-1,1)                                STYPES     283
            TDIM(LINE,1) = TDIM(LINE-1,1)                                STYPES     284
            TDIM(LINE,2) = TDIM(LINE-1,2)                                STYPES     285
            TDIM(LINE,4) = TDIM(LINE-1,4)                                STYPES     286
          END IF                                                         STYPES     287
          RETURN                                                         STYPES     288
          END                                                            STYPES     289
```

```
--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  ABOVE    NONE               UNUSED/*S*       REAL
  ANSWER   1076B                               INTEGER
  DIR      NONE               UNUSED/*S*       CHAR*3
  DOK      NONE               UNUSED/*S*       INTEGER
  FMAT     1101B                               CHAR*3
  H        NONE               UNUSED/*S*       REAL
  ID       1077B                               CHAR*3
  INSERT      1   DUMMY-ARG                    INTEGER
  LINE        2   DUMMY-ARG                    INTEGER
  LOK      NONE               UNUSED/*S*       INTEGER
```

```
 MAT       1100B                                CHAR*3
 NOK       NONE                UNUSED/*S*       INTEGER
 NROOMS    1244B  /ROOMN/                       INTEGER
 RAREA     1245B  /ROOMN/                       REAL            20
 ROOM         0B  /ROOMN/                       REAL           676
 T         NONE                UNUSED/*S*       REAL
 TDBTOT     323B  /TYPEN/                       INTEGER
 TDB1        37B  /TYPEC/                       CHAR*3          35
 TDB2       215B  /TYPEN/                       REAL            70
 TDIM         0B  /TYPEN/                       REAL           140
 TERR       324B  /TYPEN/                       INTEGER
 TTOT       214B  /TYPEN/                       INTEGER
 TYPE         0B  /TYPEC/                       CHAR*3         105
 V         NONE                UNUSED/*S*       INTEGER
 VAL       NONE                UNUSED/*S*       INTEGER
 W         NONE                UNUSED/*S*       REAL


--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE------------------------VALUE

 RMAX    INTEGER                         20
 TMAX    INTEGER                         35


--PROCEDURES--(LO=A)
 -NAME------TYPE--------ARGS------CLASS-----

 GETLEN    INTEGER         1       FUNCTION
 ICHAR     INTEGER         1       INTRINSIC


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF        -LABEL-ADDRESS-----PROPERTIES----DEF

    99       7B                    45           480     213B                   106
   100      16B                    49           500     227B                   111
   300      70B                    75           510     311B                   128
   440     147B                    91           580     377B                   149
   460     163B                    96           600     413B                   154
   470     177B                   101


--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

 DATAIN      5B     2


--I/O UNITS--(LO=A)
 -NAME--- PROPERTIES-------------

 TAPE1   FMT/SEQ


--STATISTICS--

 PROGRAM-UNIT LENGTH           1104B =   580
 CM LABELLED COMMON LENGTH     1670B =   952
 CM STORAGE USED              63000B = 26112
 COMPILE TIME                 0.328 SECONDS
```

```
      SUBROUTINE MANIP (QUIT,ABORT)                                    STYPES   290
***********************************************************************COMT       1
***   COMMON FOR DATABASE OF TYPES OF DOORS AND WINDOWS             ***COMT       2
***********************************************************************COMT       3
      INTEGER TMAX                                                     COMT       4
      PARAMETER (TMAX=35)                                              COMT       5
      COMMON /TYPEN/TDIM(TMAX,4),TTOT,TDB2(TMAX,2),TDBTOT,TERR         COMT       6
      COMMON /TYPEC/TYPE(TMAX,3),TDB1(TMAX)                            COMT       7
      INTEGER TTOT,TDBTOT,TERR                                         COMT       8
      REAL TDIM,TDB2                                                   COMT       9
      CHARACTER * 3 TYPE,TDB1                                          COMT      10
*==================================================                   COMT      11
* DESCRIPTION OF ARRAYS                                                COMT      12
*==================================================                   COMT      13
*   ID        MATERIAL    FRAME MATERIAL                               COMT      14
*--------------------------------------------------                   COMT      15
*TYPE(X,1)   TYPE(X,2)   TYPE(X,3)                                    COMT      16
* A3          A3          A3                                           COMT      17
*==================================================                   COMT      18
* HEIGHT      WIDTH       LAYER       DISTANCE                         COMT      19
*                         THICKNESS   ABOVE FLOOR                      COMT      20
*--------------------------------------------------                   COMT      21
* TDIM(X,1)   TDIM(X,2)   TDIM(X,3)   TDIM(X,4)                        COMT      22
*  F8.2         F8.2        F8.2        F8.2                           COMT      23
*==================================================                   COMT      24
*  ID       ATTENUATION    AREA                                        COMT      25
* ------------------------------------------------                    COMT      26
* TDB1(X)    TDB2(X,1)    TDB2(X,2)                                    COMT      27
*   A3          E9.3         E9.3                                      COMT      28
***********************************************************************COMT      29
***********************************************************************COMT      30
      INTEGER ABORT,ANSWER,DOK,FLAG1,LOK,N,NOK,OK,OK1,OK2,QUIT,INSERT  STYPES   292
      INTEGER TEMP,V,X,Y,COMMAND                                       STYPES   293
*                                                                      STYPES   294
10    FLAG1 = 0                                                        STYPES   295
      PRINT*                                                           STYPES   296
      PRINT*, 'CHOOSE'                                                 STYPES   297
      PRINT*, '   (1) DISPLAY LINE OF DATA  (4) DISPLAY ALL LINES'     STYPES   298
      PRINT*, '   (2) INSERT LINE INTO FILE (5) APPEND LINES OF DATA'  STYPES   299
      PRINT*, '   (3) DELETE LINE           (6) STORE DATA AND EXIT ', STYPES   300
     +        'PROGRAM'                                                STYPES   301
      PRINT*, '                             (7) EXIT PROGRAM WITHOUT ', STYPES   302
     +        'STORING DATA'                                           STYPES   303
      PRINT*, 'ENTER A NUMBER !!!'                                     STYPES   304
      PRINT*                                                           STYPES   305
      REWIND 1                                                         STYPES   306
      READ(1,*,END=10) COMMAND                                         STYPES   307
*                                                                      STYPES   308
*--------------------------------------------------------------------- STYPES   309
*** DISPLAY LINE ***                                                   STYPES   310
*--------------------------------------------------------------------- STYPES   311
      IF ( COMMAND .EQ. 1 ) THEN                                       STYPES   312
*                                                                      STYPES   313
*** INDICATE EMPTY DATA FILE                                           STYPES   314
        IF ( TTOT .EQ. 0 ) THEN                                        STYPES   315
          PRINT*                                                       STYPES   316
          PRINT*, 'DATA FILE IS EMPTY !!!'                             STYPES   317
*                                                                      STYPES   318
*** ENTER NUMBER OF LINE TO BE DISPLAYED                               STYPES   319
        ELSE                                                           STYPES   320
100       PRINT*                                                       STYPES   321
          PRINT*, 'SPECIFY THE NUMBER OF THE LINE TO BE DISPLAYED'     STYPES   322
          PRINT*, '     ( ENTER "0" TO ESCAPE DISPLAY MODE )'          STYPES   323
          REWIND 1                                                     STYPES   324
```

```
            READ(1,*,END=100) N
*
*** CHECK VALIDITY OF LINE NUMBER
            IF ( (N .GT. TTOT) .OR. (N .LT. 0) ) THEN
              PRINT*
              PRINT*, 'INCORRECT NUMBER !!!!!!       TRY AGAIN !!!'
              PRINT*, '            -OR-  ENTER "0" TO ESCAPE ID ',
     +                '"DISPLAY" MODE'
              GOTO 100
*
*** ABORT 'DISPLAY' MODE
            ELSE IF ( N .EQ. 0 ) THEN
              PRINT*
              PRINT*, '    "DISPLAY" MODE ABORTED !!!'
*
*** DISPLAY LINE OF DATA
            ELSE IF ( (N .GT. 0) .AND. (N .LE. TTOT) ) THEN
              PRINT*
              CALL DISPLAY( N, COMMAND)
*
            END IF
          END IF
        END IF
*
*-----------------------------------------------------------------------
*** INSERT LINE ***
*-----------------------------------------------------------------------
        IF ( COMMAND .EQ. 2 ) THEN
*
*** INDICATE EMPTY DATA FILE
          IF ( TTOT .EQ. 0 ) THEN
            PRINT*
            PRINT*, 'DATA FILE IS EMPTY !!!'
*
*** REQUEST NUMBER OF LINE BEFORE WHICH INSERTION IS TO BE MADE
          ELSE
 200        PRINT*
            PRINT*, 'SPECIFY NUMBER OF LINE BEFORE WHICH A NEW LINE IS ',
     +              'TO BE INSERTED'
            PRINT*, '     ( ENTER "0" TO ESCAPE "INSERTION" MODE )'
            REWIND 1
            READ(1,*,END=200) N
*
*** CHECK FOR VALID LINE NUMBER
            IF ( ( N .LT. 0 ) .OR. ( N .GT. TTOT ) ) THEN
              PRINT*
              PRINT*, 'INCORRECT NUMBER !!!'
              PRINT*, '      TRY AGAIN !!!  -OR-  ENTER "0" TO ESCAPE',
     +                '"INSERTION" MODE'
              GOTO 200
*
*** ABORT INSERTION MODE
            ELSE IF ( N .EQ. 0 ) THEN
              PRINT*
              PRINT*, '       "INSERTION" MODE ABORTED'
*
*** MAKE ROOM FOR NEW LINE OF DATA
            ELSE IF ( (N .GT. 0) .AND. (N .LE. TTOT) ) THEN
              DO 230 X = TTOT,N,-1
                DO 210 Y = 1,3
                  TYPE(X+1,Y) = TYPE(X,Y)
 210            CONTINUE
                DO 220 Y = 1,4
                  TDIM(X+1,Y) = TDIM(X,Y)
```

```
220           CONTINUE
230         CONTINUE
*
*** ENTER DATA FOR NEW LINE
            TTOT = TTOT + 1
            CALL DATAIN (1,N)
*
*** INITIALIZE FLAGS
            OK1 = 0
            OK2 = 0
            OK = 0
*
*** TEST VALIDITY OF DATA
*
***TEST IF NEW LAYER BELONGS TO THE NEXT TYPE
            IF ( ( TYPE(N,1) .EQ. TYPE(N+1,1) )
     +            .AND. ( TYPE(N,3) .EQ. TYPE(N+1,3) ) ) THEN
              IF ( ( TDIM(N,1) .EQ. TDIM(N+1,1) )
     +              .AND. ( TDIM(N,2) .EQ. TDIM(N+1,2) )
     +              .AND. ( TDIM(N,4) .EQ. TDIM(N+1,4) ) ) THEN
                OK1 = 1
              END IF
            END IF
*
*** TEST IF NEW LAYER BELONGS TO PREVIOUS TYPE
            IF ( N .GT. 1 ) THEN
              IF ( ( TYPE(N,1) .EQ. TYPE(N-1,1) )
     +              .AND. ( TYPE(N,3) .EQ. TYPE(N-1,3) ) ) THEN
                IF ( ( TDIM(N,1) .EQ. TDIM(N-1,1) )
     +                .AND. ( TDIM(N,2) .EQ. TDIM(N-1,2) )
     +                .AND. ( TDIM(N,4) .EQ. TDIM(N-1,4) ) ) THEN
                  OK2 = 1
                END IF
              END IF
            END IF
*
            IF ( ( OK1 .EQ. 1 ) .OR. ( OK2 .EQ. 1 ) ) THEN
              OK = 1
            END IF
*
            IF ( OK .EQ. 1 ) THEN
              PRINT*
              PRINT*, 'THE FOLLOWING LINE HAS BEEN ADDED AS LINE ', N
              CALL DISPLAY( N, COMMAND)
*
*** REJECT DATA IF DATA DOESN'T MATCH PREVIOUS OR NEXT LAYER
            ELSE IF ( OK .EQ. 0 ) THEN
              PRINT*
              PRINT*, 'YOUR DATA WAS NOT ACCEPTED !!!'
              PRINT*, 'YOUR DATA MUST REPRESENT A LAYER ',
     +                'IN AN EXISTING DOOR OR WINDOW'
              PRINT*, '  I.E.  THE ID, FRAME MATERIAL, HEIGHT, ',
     +               'WIDTH, AND DISTANCE ABOVE FLOOR'
              PRINT*, '        PARAMETERS MUST MATCH THE DOOR OR ',
     +                'WINDOW JUST BEFORE'
              PRINT*, '        OR JUST AFTER YOUR SPECIFIED INSERTION ',
     +                'POINT'
              PRINT*
              PRINT*, 'THE FOLLOWING DISPLAYS'
              IF ( N .GT. 1 ) PRINT*,'THE LINE BEFORE YOUR LINE,'
              PRINT*, 'YOUR LINE, AND THE LINE AFTER'
              PRINT*
*
*** DISPLAY LINES OF DATA
```

```
                 IF ( N .GT. 1 ) CALL DISPLAY ( N-1, COMMAND )
                 CALL DISPLAY( N, COMMAND)
                 CALL DISPLAY ( N+1, COMMAND)
*
*** REMOVE THE LINE OF INCORRECTLY ENTERED DATA
                 DO 270  X = N,TTOT
                   DO 250  Y = 1,3
                     TYPE(X,Y) = TYPE(X+1,Y)
250                CONTINUE
                   DO 260  Y = 1,4
                     TDIM(X,Y) = TDIM(X+1,Y)
260                CONTINUE
270              CONTINUE
                 TTOT = TTOT - 1
               END IF
             END IF
           END IF
         END IF
*
*-------------------------------------------------------------------
*** DELETE LINE ***
*-------------------------------------------------------------------
         IF ( COMMAND .EQ. 3 ) THEN
*
*** INDICATE EMPTY DATA FILE
           IF ( TTOT .EQ. 0 ) THEN
             PRINT*
             PRINT*, 'DATA FILE IS EMPTY !!!'
*
*** READ NUMBER OF LINE TO BE DELETED
           ELSE
300          PRINT*
             PRINT*, 'SPECIFY THE NUMBER OF THE LINE TO BE DELETED'
             PRINT*, '   (ENTER "0" TO ESCAPE DELETION MODE)'
             REWIND 1
             READ(1,*,END=300) N
*
*** CHECK VALIDITY OF LINE NUMBER
             IF ( (N .GT. TTOT ) .OR. ( N .LT. 0 ) ) THEN
               PRINT*
               PRINT*, ' INCORRECT NUMBER !!!'
               PRINT*, '    TRY AGAIN !!!  -OR-  ENTER "0" TO ESCAPE ID',
     +              '"DELETE" MODE'
               GOTO 300
*
*** ABORT 'DELETE' MODE
             ELSE IF ( N .EQ. 0 ) THEN
               PRINT*, '  "DELETE" MODE ABORTED'
*
*** DOUBLE CHECK CHOICE OF LINE TO BE DELETED
             ELSE IF (( N .GT. 0 ) .AND. ( N .LE. TTOT )) THEN
               PRINT*
               PRINT*, 'DOUBLE CHECK !!!'
               PRINT*, '      DO YOU WANT TO DELETE THE FOLLOWING LINE?:'
               CALL DISPLAY( N, COMMAND)
305            PRINT*, '   ENTER (1) YES  OR   (2) NO'
               REWIND 1
               READ(1,*,END=305) ANSWER
*
*** DELETE LINE
               IF ( ANSWER .EQ. 1 ) THEN
                 DO 330 X = N, TTOT - 1
                   DO 310 Y = 1,3
                     TYPE(X,Y) = TYPE(X+1,Y)
```

```
 310            CONTINUE
                DO 320 Y = 1,4
                  TDIM(X,Y) = TDIM(X+1,Y)
 320            CONTINUE
 330          CONTINUE
              TTOT = TTOT - 1
              PRINT*
              PRINT*, 'LINE # ',N,' DELETED'
            END IF
*
          END IF
        END IF
      END IF
*
*------------------------------------------------------------------------
*** DISPLAY ALL DATA ***
*------------------------------------------------------------------------
      IF ( COMMAND .EQ. 4 ) THEN
*
*** INDICATE EMPTY DATA FILE
        IF ( TTOT .EQ. 0 ) THEN
          PRINT*
          PRINT*, 'DATA FILE IS EMPTY !!!'
*
*** DISPLAY DATA
        ELSE
          PRINT*
          CALL DISPLAY( N, COMMAND)
*
        END IF
      END IF
*
*------------------------------------------------------------------------
*** ADD DATA ***
*------------------------------------------------------------------------
      IF ( COMMAND .EQ. 5 ) THEN
*
*** ENTER DATA
 500    TTOT = TTOT + 1
*
        CALL DATAIN (0,TTOT)
 510    PRINT*
        PRINT*, 'DO YOU WANT TO ENTER MORE DATA?   (1) YES  (2) NO'
        PRINT*, '   ENTER A NUMBER !!!'
        REWIND 1
        READ(1,*,END=510) ANSWER
*
*** CHECK VALIDITY OF NUMBER
*
*** ENTER MORE DATA
        IF ( ANSWER .EQ. 1 ) THEN
          GOTO 500
*
*** DISCONTINUE DATA ENTRY
        ELSE IF ( ANSWER .EQ. 2 ) THEN
          PRINT*
          PRINT*, 'DATA ENTRY DISCONTINUED'
*
*** INVALID ENTRY
        ELSE
          GOTO 510
        END IF
      END IF
*
```

```
*----------------------------------------------------------------------
*** STORE DATA AND PROGRAM ***
*----------------------------------------------------------------------
      IF ( COMMAND .EQ. 6 ) THEN
 600    PRINT*
        PRINT*, 'DOUBLE CHECK !!!'
        PRINT*, '    DO YOU YOU WANT TO STORE THIS DATA AND END PROG'
        PRINT*, ' NOTE. STORING THIS DATA WILL WIPE OUT ANY OLD FILE '
        PRINT*, ' OF THE SAME NAME !!!'
        PRINT*, '         ENTER A NUMBER: (1) YES   (2) NO'
        REWIND 1
        READ(1,*,END=600) ANSWER
*
*** SET FLAG FOR STORING DATA IN THE MAIN PROGRAM
        IF ( ANSWER .EQ. 1 ) THEN
          QUIT = 1
          RETURN
*
*** ABORT 'STORING' MODE
        ELSE IF ( ANSWER .EQ. 2 ) THEN
          PRINT*
          PRINT*, '    "STORING" MODE DISCONTINUED'
*
*** CHECK VALIDITY OF ANSWER
        ELSE IF ( ( ANSWER .NE. 1 ) .AND. ( ANSWER .NE. 2 ) ) THEN
          GOTO 600
*
        END IF
      END IF
*
*----------------------------------------------------------------------
*** END PROGRAM WITHOUT STORING DATA ***
*----------------------------------------------------------------------
      IF ( COMMAND .EQ. 7 ) THEN
 700    PRINT*
        PRINT*, 'DOUBLE CHECK !!!'
        PRINT*, '    DO YOU WANT TO END THIS PROGRAM ',
     +          'WITHOUT STORING DATA?'
        PRINT*, '         ENTER A NUMBER: (1) YES   (2) NO'
        REWIND 1
        READ(1,*,END=700) ANSWER
*
*** SET FLAG FOR ABORTING PROGRAM IN THE MAIN PROGRAM
        IF ( ANSWER .EQ. 1 ) THEN
          ABORT = 1
          RETURN
*
*** ABORT 'STORING' MODE
        ELSE IF ( ANSWER .EQ. 2 ) THEN
          PRINT*
          PRINT*, '    "ABORTION" MODE DISCONTINUED'
*
*** CHECK VALIDITY OF ANSWER
        ELSE IF ( ( ANSWER .NE. 1 ) .AND. ( ANSWER .NE. 2 ) ) THEN
          GOTO 700
*
        END IF
      END IF
*
*----------------------------------------------------------------------
*** LOOP TO BEGINNING OF 'MANIP' SUBROUTINE
*----------------------------------------------------------------------
      GOTO 10
*
```

```
    385       RETURN                                                        STYPES     645
TRIVIAL* NO PATH TO THIS STATEMENT
    386       END                                                           STYPES     646
```

```
--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  ABORT        2   DUMMY-ARG                   INTEGER
  ANSWER   2030B                               INTEGER
  COMMAND  2040B                               INTEGER
  DOK      NONE               UNUSED/*S*       INTEGER
  FLAG1    2031B                               INTEGER
  INSERT   NONE               UNUSED/*S*       INTEGER
  LOK      NONE               UNUSED/*S*       INTEGER
  N        2032B                               INTEGER
  NOK      NONE               UNUSED/*S*       INTEGER
  OK       2033B                               INTEGER
  OK1      2034B                               INTEGER
  OK2      2035B                               INTEGER
  QUIT         1   DUMMY-ARG                   INTEGER
  TDBTOT    323B   /TYPEN/                     INTEGER
  TDB1       37B   /TYPEC/                     CHAR*3          35
  TDB2      215B   /TYPEN/                     REAL            70
  TDIM        0B   /TYPEN/                     REAL           140
  TEMP     NONE               UNUSED/*S*       INTEGER
  TERR      324B   /TYPEN/                     INTEGER
  TTOT      214B   /TYPEN/                     INTEGER
  TYPE        0B   /TYPEC/                     CHAR*3         105
  V        NONE               UNUSED/*S*       INTEGER
  X        2036B                               INTEGER
  Y        2037B                               INTEGER
```

```
--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE------------------------VALUE

  TMAX    INTEGER                        35
```

```
--PROCEDURES--(LO=A)
 -NAME------TYPE--------ARGS------CLASS-----

  DATAIN                  2      SUBROUTINE
  DISPLAY                 2      SUBROUTINE
```

```
--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF        -LABEL-ADDRESS-----PROPERTIES----DEF

    10      7B                      35          300    547B                    224
   100     50B                      61          305    616B                    248
   200    133B                     101          310  INACTIVE   DO-TERM        257
   210  INACTIVE    DO-TERM        126          320  INACTIVE   DO-TERM        260
   220  INACTIVE    DO-TERM        129          330  INACTIVE   DO-TERM        261
   230  INACTIVE    DO-TERM        130          500    741B                    295
   250  INACTIVE    DO-TERM        201          510    745B                    298
   260  INACTIVE    DO-TERM        204          600   1001B                    325
   270  INACTIVE    DO-TERM        205          700   1053B                    355
```

```
--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  MANIP       5B     2


--I/O UNITS--(LO=A)
 -NAME--- PROPERTIES-------------

  TAPE1   FMT/SEQ


--STATISTICS--

  PROGRAM-UNIT LENGTH           2054B =  1068
  CM LABELLED COMMON LENGTH      377B =  255
  CM STORAGE USED              63000B =  26112
  COMPILE TIME                 0.553 SECONDS

      1  TRIVIAL   ERROR IN  MANIP
```

```
      SUBROUTINE DISPLAY (LINE, COMMAND)                                STYPES   647
************************************************************************COMT       1
***   COMMON FOR DATABASE OF TYPES OF DOORS AND WINDOWS              ***COMT       2
************************************************************************COMT       3
      INTEGER TMAX                                                      COMT       4
      PARAMETER (TMAX=35)                                               COMT       5
      COMMON /TYPEN/TDIM(TMAX,4),TTOT,TDB2(TMAX,2),TDBTOT,TERR          COMT       6
      COMMON /TYPEC/TYPE(TMAX,3),TDB1(TMAX)                             COMT       7
      INTEGER TTOT,TDBTOT,TERR                                          COMT       8
      REAL TDIM,TDB2                                                    COMT       9
      CHARACTER * 3 TYPE,TDB1                                           COMT      10
*==================================================                     COMT      11
* DESCRIPTION OF ARRAYS                                                 COMT      12
*==================================================                     COMT      13
*   ID        MATERIAL    FRAME MATERIAL                                COMT      14
*--------------------------------------------------                     COMT      15
*TYPE(X,1)   TYPE(X,2)   TYPE(X,3)                                     COMT      16
* A3          A3          A3                                            COMT      17
*==================================================                     COMT      18
* HEIGHT      WIDTH       LAYER       DISTANCE                          COMT      19
*                         THICKNESS   ABOVE FLOOR                       COMT      20
*--------------------------------------------------                     COMT      21
* TDIM(X,1)   TDIM(X,2)   TDIM(X,3)   TDIM(X,4)                         COMT      22
*  F8.2        F8.2        F8.2        F8.2                             COMT      23
*==================================================                     COMT      24
*  ID      ATTENUATION    AREA                                          COMT      25
* ------------------------------------------------                      COMT      26
* TDB1(X)    TDB2(X,1)    TDB2(X,2)                                     COMT      27
*   A3           E9.3          E9.3                                     COMT      28
************************************************************************COMT      29
************************************************************************COMT      30
      INTEGER LINE, COMMAND, N                                          STYPES   649
 1000 FORMAT (1X,A5,2X,A2,2X,A8,2X,A8,2X,A11,2X,A9,2X,A8,2X,A8)         STYPES   650
 2000 FORMAT (2X,I3,3X,A2,3X,F6.2,4X,F6.2,4X,F6.2,7X,F6.2,6X,A3,        STYPES   651
     +       7X,A3)                                                     STYPES   652
      PRINT 1000, 'LINE','ID','HEIGHT  ','WIDTH   ','DISTANCE   ',      STYPES   653
     +             'THICKNESS','LAYER    ','FRAME    '                  STYPES   654
      PRINT 1000,' ',' ','(METERS)','(METERS)','ABOVE FLOOR',           STYPES   655
     +            '(CM)      ','MATERIAL','MATERIAL'                    STYPES   656
      IF ( COMMAND .EQ. 4 ) THEN                                        STYPES   657
        DO 10 LINE = 1,TTOT                                             STYPES   658
          PRINT 2000, LINE,TYPE(LINE,1),TDIM(LINE,1),TDIM(LINE,2),      STYPES   659
     +             TDIM(LINE,4),TDIM(LINE,3),TYPE(LINE,2),TYPE(LINE,3)  STYPES   660
 10     CONTINUE                                                        STYPES   661
      ELSE                                                              STYPES   662
          PRINT 2000, LINE,TYPE(LINE,1),TDIM(LINE,1),TDIM(LINE,2),      STYPES   663
     +             TDIM(LINE,4),TDIM(LINE,3),TYPE(LINE,2),TYPE(LINE,3)  STYPES   664
      END IF                                                            STYPES   665
      RETURN                                                            STYPES   666
      END                                                               STYPES   667
```

```
--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  COMMAND      2   DUMMY-ARG                  INTEGER
  LINE         1   DUMMY-ARG                  INTEGER
  N          NONE             UNUSED/*S*      INTEGER
  TDBTOT     323B  /TYPEN/                    INTEGER
  TDB1        37B  /TYPEC/                    CHAR*3          35
  TDB2       215B  /TYPEN/                    REAL            70
  TDIM        0B   /TYPEN/                    REAL           140
  TERR       324B  /TYPEN/                    INTEGER
  TTOT       214B  /TYPEN/                    INTEGER
```

```
 TYPE        0B  /TYPEC/                     CHAR*3        105


--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE------------------------VALUE

 TMAX    INTEGER                        35


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

    10  INACTIVE   DO-TERM        44
  1000    163B     FORMAT         33
  2000    171B     FORMAT         34


--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

 DISPLAY     5B     2


--STATISTICS--

 PROGRAM-UNIT LENGTH             254B =  172
 CM LABELLED COMMON LENGTH       377B =  255
 CM STORAGE USED               61000B =  25088
 COMPILE TIME                  0 100 SECONDS
```

```
      INTEGER FUNCTION VAL(STRING)                                  STYPES   668
C** RETURNS THE INTEGER VALUE OF A STRING.                          STYPES   669
      INTEGER NUMBER, X,L,EXP,DIGIT,GETLEN                          STYPES   670
      CHARACTER * (*) STRING                                        STYPES   671
      L = GETLEN(STRING)                                            STYPES   672
      NUMBER = 0                                                    STYPES   673
      DO 10 X = L,1,-1                                              STYPES   674
      EXP = L - X                                                   STYPES   675
      DIGIT = ICHAR(STRING(X:X)) - 16                               STYPES   676
      NUMBER = NUMBER + DIGIT*10**EXP                               STYPES   677
 10   CONTINUE                                                      STYPES   678
      VAL = NUMBER                                                  STYPES   679
      RETURN                                                        STYPES   680
      END                                                           STYPES   681
```

```
--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  DIGIT      76B                             INTEGER
  EXP        75B                             INTEGER
  L          74B                             INTEGER
  NUMBER     72B                             INTEGER
  STRING      1   DUMMY-ARG                  CHAR*(*)
  VAL        71B                             INTEGER
  X          73B                             INTEGER


--PROCEDURES--(LO=A)
 -NAME------TYPE--------ARGS------CLASS-----

  GETLEN    INTEGER       1      FUNCTION
  ICHAR     INTEGER       1      INTRINSIC


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

    10  INACTIVE   DO-TERM       11


--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  VAL         6B     1


--STATISTICS--

  PROGRAM-UNIT LENGTH            102B =   66
  CM STORAGE USED              61000B = 25088
  COMPILE TIME                 0.041 SECONDS
```

```
      INTEGER FUNCTION GETLEN (STRING)                                  STYPES   682
C                                                                       STYPES   683
C DETERMINE LENGTH OF STRING EXCLUDING ANY BLANK PADDING                STYPES   684
C                                                                       STYPES   685
C                                                                       STYPES   686
C ARGUMENT DEFINITIONS --                                               STYPES   687
C   READ ARGUMENTS                                                      STYPES   688
C     STRING - STRING WHOSE LENGTH IS TO BE DETERMINED                  STYPES   689
C                                                                       STYPES   690
      CHARACTER * (*) STRING                                            STYPES   691
C                                                                       STYPES   692
C FUNCTION PARAMETERS                                                   STYPES   693
      CHARACTER * 1 BLANK                                               STYPES   694
      PARAMETER (BLANK = ' ')                                           STYPES   695
C                                                                       STYPES   696
C LOCAL VARIABLES                                                       STYPES   697
      INTEGER NEXT                                                      STYPES   698
C                                                                       STYPES   699
C START WITH THE LAST CHARACTER AND FIND THE FIRST NON-BLANK            STYPES   700
      DO 10 NEXT = LEN(STRING),1,-1                                     STYPES   701
         IF (STRING(NEXT : NEXT) .NE. BLANK) THEN                       STYPES   702
            GETLEN = NEXT                                               STYPES   703
            RETURN                                                      STYPES   704
         END IF                                                         STYPES   705
   10 CONTINUE                                                          STYPES   706
C                                                                       STYPES   707
C ALL CHARACTERS ARE BLANKS                                             STYPES   708
      GETLEN = 0                                                        STYPES   709
C                                                                       STYPES   710
      RETURN                                                            STYPES   711
      END                                                               STYPES   712
```

```
--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  GETLEN     63B                             INTEGER
  NEXT       64B                             INTEGER
  STRING       1   DUMMY-ARG                 CHAR*(*)


--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE------------------------VALUE

  BLANK   CHAR*1                       ' '


--PROCEDURES--(LO=A)
 -NAME------TYPE--------ARGS------CLASS-----

  LEN       INTEGER        1      INTRINSIC


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

    10  INACTIVE   DO-TERM        25
```

```
FTN 5.1+552          83/12/24. 10.36.12 PAGE    22
  FUNCTION GETLEN   74/175  OPT=0

--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  GETLEN      6B      1


--STATISTICS--

  PROGRAM-UNIT LENGTH            70B =  56
  CM STORAGE USED             61000B =  25088
  COMPILE TIME               0.041 SECONDS
```

```
      SUBROUTINE LTYPE                                                  LTYPE
*!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!LTYPE
*!!!                                                                 !!!LTYPE
*!!!  LOAD THE "TYPE" ARRAYS FROM THE TYPE DATA FILE                 !!!LTYPE
*!!!                                                                 !!!LTYPE
*!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!LTYPE
************************************************************************LTYPE
************************************************************************COMT
***   COMMON FOR DATABASE OF TYPES OF DOORS AND WINDOWS              ***COMT
************************************************************************COMT
      INTEGER TMAX                                                      COMT
      PARAMETER (TMAX=35)                                               COMT
      COMMON /TYPEN/TDIM(TMAX,4),TTOT,TDB2(TMAX,2),TDBTOT,TERR          COMT
      COMMON /TYPEC/TYPE(TMAX,3),TDB1(TMAX)                             COMT
      INTEGER TTOT,TDBTOT,TERR                                          COMT
      REAL TDIM,TDB2                                                    COMT
      CHARACTER * 3 TYPE,TDB1                                           COMT
*================================================                       COMT
* DESCRIPTION OF ARRAYS                                                 COMT
*================================================                       COMT
*   ID        MATERIAL    FRAME MATERIAL                                COMT
*------------------------------------------------                       COMT
*TYPE(X,1)   TYPE(X,2)   TYPE(X,3)                                      COMT
* A3          A3          A3                                            COMT
*================================================                       COMT
* HEIGHT      WIDTH       LAYER       DISTANCE                          COMT
*                         THICKNESS   ABOVE FLOOR                       COMT
*------------------------------------------------                       COMT
* TDIM(X,1)   TDIM(X,2)   TDIM(X,3)   TDIM(X,4)                         COMT
*  F8.2        F8.2        F8.2        F8.2                             COMT
*================================================                       COMT
*  ID       ATTENUATION    AREA                                         COMT
* -----------------------------------------------                       COMT
* TDB1(X)    TDB2(X,1)    TDB2(X,2)                                     COMT
*   A3          E9.3         E9.3                                       COMT
************************************************************************COMT
************************************************************************COMT
************************************************************************COMF
*** COMMON FOR INITIAL PARAMETERS                                    ***COMF
************************************************************************COMF
      INTEGER FMAX                                                      COMF
      PARAMETER (FMAX = 50)                                             COMF
      COMMON /INITILN/ FREQ, QUALITY, AFLAG, RFLAG, FREQA(FMAX), FERR,  COMF
     $                 FTOT                                             COMF
      COMMON /INITILC/ BLDG                                             COMF
      CHARACTER * 5 BLDG                                                COMF
      REAL FREQ, AFLAG, RFLAG, FREQA                                    COMF
      INTEGER QUALITY, FERR, FTOT                                       COMF
************************************************************************COMF
************************************************************************COMF
************************************************                        LTYPE
*   DECLARATION OF VARIABLES                                            LTYPE
************************************************                        LTYPE
      INTEGER GETLEN, R, C                                              LTYPE
      CHARACTER * 7  PFN                                                LTYPE
************************************************                        LTYPE
*                                                                       LTYPE
************************************************                        LTYPE
      PFN = 'B' // BLDG(1:GETLEN(BLDG)) // 'T'                          LTYPE
      TERR = 0                                                          LTYPE
      CALL  PF ('GET',0,PFN(1:GETLEN(PFN)),'RC',TERR)                   LTYPE
      IF (TERR .EQ. 0 ) THEN                                            LTYPE
        OPEN (UNIT=3, FILE=PFN, FORM='FORMATTED',                       LTYPE
     $        STATUS='OLD', ACCESS='SEQUENTIAL')                        LTYPE
```

```
65 1000     FORMAT (1X,3(1X,A3),4(1X,F8.2))                                          LTYPE         24
66          TTOT = 0                                                                 LTYPE         25
67          DO 10 R = 1,TMAX                                                         LTYPE         26
68            READ (3,1000,END=20)(TYPE(R,C),C=1,3),(TDIM(R,C),C=1,4)                LTYPE         27
69            TTOT = TTOT + 1                                                        LTYPE         28
70 10       CONTINUE                                                                 LTYPE         29
71 20       CONTINUE                                                                 LTYPE         30
72          CLOSE(3,STATUS='DELETE')                                                 LTYPE         31
73        ELSE IF ( TERR .EQ. 2 ) THEN                                               LTYPE         32
74          CALL WARNING (5)                                                         LTYPE         33
75        ELSE                                                                       LTYPE         34
76          CALL WARNING (6)                                                         LTYPE         35
77        END IF                                                                     LTYPE         36
78        RETURN                                                                     LTYPE         37
79        END                                                                        LTYPE         38
```

```
--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  AFLAG       2B  /INITILN/                  REAL
  BLDG        0B  /INITILC/                  CHAR*5
  C         236B                             INTEGER
  FERR       66B  /INITILN/                  INTEGER
  FREQ        0B  /INITILN/                  REAL
  FREQA       4B  /INITILN/                  REAL             50
  FTOT       67B  /INITILN/                  INTEGER
  PFN       237B                             CHAR*7
  QUALITY     1B  /INITILN/                  INTEGER
  R         235B                             INTEGER
  RFLAG       3B  /INITILN/                  REAL
  TDBTOT    323B  /TYPEN/                    INTEGER
  TDB1       37B  /TYPEC/                    CHAR*3           35
  TDB2      215B  /TYPEN/                    REAL             70
  TDIM        0B  /TYPEN/                    REAL            140
  TERR      324B  /TYPEN/                    INTEGER
  TTOT      214B  /TYPEN/                    INTEGER
  TYPE        0B  /TYPEC/                    CHAR*3          105


--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE------------------------VALUE

  FMAX    INTEGER                        50
  TMAX    INTEGER                        35


--PROCEDURES--(LO=A)
 -NAME------TYPE--------ARGS------CLASS-----

  GETLEN    INTEGER          1       FUNCTION
  PF                         5       SUBROUTINE
  WARNING                    1       SUBROUTINE


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

    10  INACTIVE    DO-TERM        70
    20    111B                     71
  1000    147B      FORMAT         65
```

FTN 5.1+552   83/12/24. 10.36.12 PAGE   25
SUBROUTINE LTYPE   74/175 OPT=0

```
--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  LTYPE        5B      0


--I/O UNITS--(LO=A)
 -NAME--- PROPERTIES-------------

  TAPE3   AUX/FMT/SEQ


--STATISTICS--

  PROGRAM-UNIT LENGTH                245B =   165
  CM LABELLED COMMON LENGTH          470B =   312
  CM STORAGE USED                  63000B = 26112
  COMPILE TIME                     0.107 SECONDS
```

```
   1          SUBROUTINE ERROR(IERR)                                                  ERROR        1
   2          CHARACTER*45 MESSAGE(20)                                                ERROR        2
   3          DATA MESSAGE( 1)/'MATERIALS DATA BASE IS EMPTY                       '/ ERROR        3
   4          DATA MESSAGE( 2)/'FREQUENCY IS OUT OF RANGE                          '/ ERROR        4
   5          DATA MESSAGE( 3)/'THIS MATERIAL IS NOT IN DATA BASE                  '/ ERROR        5
   6          DATA MESSAGE( 4)/'DENOMINATOR IS ZERO                                '/ ERROR        6
   7          DATA MESSAGE( 5)/'FILE HANDLING ERROR                                '/ ERROR        7
   8          DATA MESSAGE( 6)/'ERROR CODE IS OUT OF RANGE                         '/ ERROR        8
   9          DATA MESSAGE( 7)/'ERROR CODE IS OUT OF RANGE                         '/ ERROR        9
  10          DATA MESSAGE( 8)/'ERROR CODE IS OUT OF RANGE                         '/ ERROR       10
  11          DATA MESSAGE( 9)/'ERROR CODE IS OUT OF RANGE                         '/ ERROR       11
  12          DATA MESSAGE(10)/'ERROR CODE IS OUT OF RANGE                         '/ ERROR       12
  13          DATA MESSAGE(11)/'ERROR CODE IS OUT OF RANGE                         '/ ERROR       13
  14          DATA MESSAGE(12)/'ERROR CODE IS OUT OF RANGE                         '/ ERROR       14
  15          DATA MESSAGE(13)/'ERROR CODE IS OUT OF RANGE                         '/ ERROR       15
  16          DATA MESSAGE(14)/'ERROR CODE IS OUT OF RANGE                         '/ ERROR       16
  17          DATA MESSAGE(15)/'ERROR CODE IS OUT OF RANGE                         '/ ERROR       17
  18          DATA MESSAGE(16)/'ERROR CODE IS OUT OF RANGE                         '/ ERROR       18
  19          DATA MESSAGE(17)/'ERROR CODE IS OUT OF RANGE                         '/ ERROR       19
  20          DATA MESSAGE(18)/'ERROR CODE IS OUT OF RANGE                         '/ ERROR       20
  21          DATA MESSAGE(19)/'ERROR CODE IS OUT OF RANGE                         '/ ERROR       21
  22          DATA MESSAGE(20)/'ERROR CODE IS OUT OF RANGE                         '/ ERROR       22
  23          IERRM=5                                                                 ERROR       23
  24          IF(IERR.GT.IERRM) IERR=20                                               ERROR       24
  25          WRITE(6,10) IERR,MESSAGE(IERR)                                          ERROR       25
  26   10     FORMAT(' ***ERROR NUMBER = ',I5,' ***  ',A45)                           ERROR       26
  27          CALL PMDSTOP                                                            ERROR       27
  28          STOP 'ERROR'                                                            ERROR       28
  29          END                                                                     ERROR       29
```

```
--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  IERR        1   DUMMY-ARG                  INTEGER
  IERRM     210B                             INTEGER
  MESSAGE    56B                             CHAR*45        20


--PROCEDURES--(LO=A)
 -NAME------TYPE--------ARGS------CLASS-----

  PMDSTOP                  0      SUBROUTINE


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

    10      36B     FORMAT          26


--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  ERROR       5B      1
```



```
--I/O UNITS--(LO=A)
 -NAME--- PROPERTIES-------------

  TAPE6   FMT/SEQ


--STATISTICS--

  PROGRAM-UNIT LENGTH                213B =   139
  CM STORAGE USED                  61000B = 25088
  COMPILE TIME                     0.054 SECONDS
```

```
          SUBROUTINE WARNING(ERR)                                          WARNING      1
          INTEGER ERR, ERRM                                                WARNING      2
          CHARACTER*45 MESSAGE(20)                                         WARNING      3
          DATA MESSAGE( 1)/'"HOLE" DATA FILE DOES NOT EXIST FOR THIS BLDG'/ WARNING     4
          DATA MESSAGE( 2)/'FILE HANDLING PROBLEM ON "HOLE" DATA FILE    '/ WARNING     5
          DATA MESSAGE( 3)/'"MATTER" FILE DOES NOT EXIST FOR THIS BLDG   '/ WARNING     6
          DATA MESSAGE( 4)/'FILE HANDLING PROBLEM ON "MATTER FILE        '/ WARNING     7
          DATA MESSAGE( 5)/'"TYPE" DATA FILE DOES NOT EXIST FOR THIS BLDG'/ WARNING     8
          DATA MESSAGE( 6)/'FILE HANDLING PROBLEM ON "TYPE" FILE         '/ WARNING     9
          DATA MESSAGE( 7)/'"WALL" DATA FILE DOES NOT EXIST FOR THIS BLDG'/ WARNING    10
          DATA MESSAGE( 8)/'FILE HANDLING PROBLEM ON "WALL" FILE         '/ WARNING    11
          DATA MESSAGE( 9)/'HEIGHT AND WIDTH OF ROOM MISSING             '/ WARNING    12
          DATA MESSAGE(10)/'LENGTH OF ROOM IS MISSING                    '/ WARNING    13
          DATA MESSAGE(11)/'FREQ FILE DOES NOT EXIST FOR THIS BLDG       '/ WARNING    14
          DATA MESSAGE(12)/'FILE HANDLING PROBLEM WITH FREQ FILE         '/ WARNING    15
          DATA MESSAGE(13)/'WARNING CODE IS OUT OF RANGE                 '/ WARNING    16
          DATA MESSAGE(14)/'WARNING CODE IS OUT OF RANGE                 '/ WARNING    17
          DATA MESSAGE(15)/'WARNING CODE IS OUT OF RANGE                 '/ WARNING    18
          DATA MESSAGE(16)/'WARNING CODE IS OUT OF RANGE                 '/ WARNING    19
          DATA MESSAGE(17)/'WARNING CODE IS OUT OF RANGE                 '/ WARNING    20
          DATA MESSAGE(18)/'WARNING CODE IS OUT OF RANGE                 '/ WARNING    21
          DATA MESSAGE(19)/'WARNING CODE IS OUT OF RANGE                 '/ WARNING    22
          DATA MESSAGE(20)/'WARNING CODE IS OUT OF RANGE                 '/ WARNING    23
          ERRM=12                                                          WARNING     24
          IERR = ERR                                                       WARNING     25
          IF(ERR.GT.ERRM) IERR=20                                          WARNING     26
          WRITE(6,20)                                                      WARNING     27
          WRITE(6,10) ERR,MESSAGE(IERR)                                    WARNING     28
          WRITE(6,20)                                                      WARNING     29
   10     FORMAT(' ***WARNING NUMBER = ',I5,' ***  ',A45)                  WARNING     30
   20     FORMAT('     ')                                                  WARNING     31
          RETURN                                                           WARNING     32
          END                                                              WARNING     33
```

```
--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  ERR         1   DUMMY-ARG                  INTEGER
  ERRM      60B                              INTEGER
  IERR     213B                              INTEGER
  MESSAGE   61B                              CHAR*45        20


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

    10     34B     FORMAT         30
    20     42B     FORMAT         31


--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  WARNING     5B     1
```



```
--I/O UNITS--(LO=A)
 -NAME--- PROPERTIES-------------

  TAPE6   FMT/SEQ


--STATISTICS--

  PROGRAM-UNIT LENGTH             216B =   142
  CM STORAGE USED               61000B = 25088
  COMPILE TIME                  0.058 SECONDS
```

Appendix 9.6 Listing of Computer Program SFREQ

```
      PROGRAM SFREQ (INPUT,TAPE1=INPUT)                                 SFREQ
*                                                                       SFREQ
*THIS INTERACTIVE PROGRAM INPUTS THE DATA DESCRIBING EACH FREQ          SFREQ
*IN THE BUILDING AND STORES IT.  THE FILE NAME IS CREATED BY            SFREQ
*ATTACHING "B" TO THE FRONT OF AND "F" TO THE BACK OF THE BUILDING      SFREQ
*IDENTIFICATION. THE BUILDING IDENTIFICATION CAN BE NO MORE             SFREQ
*THAN 5 ALPHANUMERIC CHARACTERS.                                        SFREQ
                                                                        SFREQ
************************************************************************COMF
*** COMMON FOR INITIAL PARAMETERS                                    ***COMF
************************************************************************COMF
      INTEGER FMAX                                                      COMF
      PARAMETER (FMAX = 50)                                             COMF
      COMMON /INITILN/ FREQ, QUALITY, AFLAG, RFLAG, FREQA(FMAX), FERR,  COMF
     $                 FTOT                                             COMF
      COMMON /INITILC/ BLDG                                             COMF
      CHARACTER * 5 BLDG                                                COMF
      REAL FREQ, AFLAG, RFLAG, FREQA                                    COMF
      INTEGER QUALITY, FERR, FTOT                                       COMF
************************************************************************COMF
************************************************************************COMF
      INTEGER GETLEN,QUIT,ABORT,ANSWER,OLDFILE,N,Y1,Y2,LINE             SFREQ
      INTEGER IERR                                                      SFREQ
      CHARACTER * 7  PFN                                                SFREQ
*                                                                       SFREQ
* INITIALIZATION                                                        SFREQ
      QUIT = 0                                                          SFREQ
      FTOT = 0                                                          SFREQ
      ABORT = 0                                                         SFREQ
100   PRINT*                                                            SFREQ
      PRINT *, 'ENTER BUILDING IDENTIFICATION  (E.G. ''101'')'          SFREQ
      PRINT *, '    (NO MORE THAN 5 ALPHANUMERIC CHARACTERS)'           SFREQ
      REWIND 1                                                          SFREQ
      READ(1,*,END=100) BLDG                                            SFREQ
                                                                        SFREQ
      IF ( GETLEN(BLDG) .GT. 5 ) THEN                                   SFREQ
        GO TO 100                                                       SFREQ
      END IF                                                            SFREQ
      PFN = 'B' // BLDG(1:GETLEN(BLDG)) // 'F'                          SFREQ
*                                                                       SFREQ
*** LOAD DATA FROM EXISTING FILE IF NECESSARY                           SFREQ
200   PRINT*                                                            SFREQ
      PRINT*,'WILL THIS BE'                                             SFREQ
      PRINT*,'   (1) A MODIFICATION OF AN EXISTING FILE?'               SFREQ
      PRINT*,'   (2) A NEW FILE?'                                       SFREQ
      PRINT*,'ENTER A NUMBER  !!!'                                      SFREQ
      REWIND 1                                                          SFREQ
      READ(1,*,END=200) OLDFILE                                         SFREQ
      IF ( ( OLDFILE .NE. 1 ) .AND. ( OLDFILE .NE. 2 ) ) THEN           SFREQ
        GOTO 200                                                        SFREQ
      ELSE IF ( OLDFILE .EQ. 1 ) THEN                                   SFREQ
*                                                                       SFREQ
*** CHECK FOR EXISTENCE OF PERMANENT FILE OF SAME NAME                  SFREQ
        IERR = 0                                                        SFREQ
        CALL PF ('GET',0,PFN(1:GETLEN(PFN)),'RC',IERR)                  SFREQ
        IF ( IERR .EQ. 2 ) THEN                                         SFREQ
          PRINT*                                                        SFREQ
          PRINT *, 'FILE ',PFN, ' NOT FOUND'                            SFREQ
          PRINT*, 'PROGRAM ABORTED!!!'                                  SFREQ
          PRINT*                                                        SFREQ
          PRINT*, 'FIND CORRECT BUILDING IDENTIFIER AND RESTART ',      SFREQ
     +            'PROGRAM'                                             SFREQ
          PRINT*                                                        SFREQ
          STOP                                                          SFREQ
```

```
*
        ELSE
          CALL LFREQ
          IF (FERR .NE. 0) CALL ERROR(5)
        END IF
      ELSE IF ( OLDFILE .EQ. 2 ) THEN
*
*** CHECK FOR EXISTENCE OF PERMANENT FILE OF SAME NAME
        IERR = 0
        CALL PF ('GET',0,PFN(1:GETLEN(PFN)),'RC',IERR)
        IF ( IERR .EQ. 0 ) THEN
          PRINT*
          PRINT*, 'DATA FILE ALREADY EXISTS FOR BUILDING ',BLDG
          PRINT*
          PRINT*,'IF YOU ENTER DATA AND STORE IT, YOU WILL WRITE ',
     +            'OVER THE OLD FILE.'
 250      PRINT*
          PRINT*,'YOU MAY EITHER (1) ABORT OR (2) CONTINUE.'
          PRINT*,'INDICATE YOUR CHOICE BY ENTERING A NUMBER.'
          REWIND 1
          READ(1,*,END=250) ANSWER
          IF ( ANSWER .EQ. 1 ) THEN
            PRINT*
            PRINT*,'PROGRAM HAS BEEN ABORTED, AT YOUR REQUEST'
            PRINT*
            STOP
          ELSE IF ( ANSWER .EQ. 2 ) THEN
 9090       CONTINUE
          ELSE
            GOTO 250
          END IF
        ELSE IF ( IERR .EQ. 2 ) THEN
*
*** NO DATA FILE ALREADY EXISTS FOR THIS BUILDING AND DATA ENTRY
*** CAN CONTINUE
 9091     CONTINUE
        ELSE
*
*** PERMANENT FILE ERROR
          PRINT*
          PRINT*,'PROGRAM ABORTED !!!'
          PRINT*,'   SOME PERMANENT FILE ERROR HAS OCCURRED.'
          PRINT*,'   DOUBLE CHECK YOUR BUILDING IDENTIFICATION ',
     +            'AND TRY AGAIN'
          STOP
        END IF
*
        PRINT*
        PRINT*, ' BEGIN ENTERING DATA'
 300    FTOT = FTOT + 1
        IF ( FTOT .EQ. 1) THEN
          CALL DATAIN(1,FTOT)
        ELSE
          CALL DATAIN (0,FTOT)
        END IF
 400    PRINT*
        PRINT*, 'DO YOU WANT TO ENTER MORE DATA?',
     +          '(1) YES  (2) NO'
        PRINT*, '  ENTER A NUMBER !!!'
        REWIND 1
        READ(1,*,END=400) ANSWER
        IF ( (ANSWER .NE. 1) .AND. (ANSWER .NE. 2) ) THEN
          GOTO 400
        ELSE IF ( ANSWER .EQ. 1) THEN
```

```
          GOTO 300
        ELSE IF ( ANSWER .EQ. 2 ) THEN
          PRINT*
          PRINT*, 'DATA ENTRY DISCONTINUED'
        END IF
      END IF
*
*** MANIPULATE DATA
      CALL MANIP (QUIT,ABORT)
*
*** TERMINATE PROGRAM, STORING DATA IF NECESSARY
      IF ( QUIT .EQ. 1 ) THEN
       OPEN(UNIT=6,FILE=PFN(1:GETLEN(PFN)),FORM='FORMATTED',
     +           ACCESS='SEQUENTIAL',STATUS='NEW')
500     FORMAT (1PE12.6)
        DO 600 N = 1,FTOT
          WRITE (6,500) FREQA(N)
600     CONTINUE
        ENDFILE(6)
        CALL PF ('REPLACE',0,PFN(1:GETLEN(PFN)))
WARNING* NUMBER OF ARGUMENTS IN REFERENCE TO _PF IS NOT CONSISTENT
        CLOSE(6,STATUS='DELETE')
        PRINT*
        PRINT*,'DATA HAS BEEN STORED AND PROGRAM TERMINATED'
      END IF
      IF( ABORT .EQ. 1 ) THEN
        PRINT*
        PRINT*, 'PROGRAM HAS BEEN ABORTED'
        PRINT*,'      NO DATA HAS BEEN STORED !!!'
      END IF
      STOP
      END
```

--VARIABLE MAP--(LO=A)

-NAME---	ADDRESS--	BLOCK-----	PROPERTIES-------	TYPE---------	SIZE
ABORT	1031B			INTEGER	
AFLAG	2B	/INITILN/		REAL	
ANSWER	1032B			INTEGER	
BLDG	0B	/INITILC/		CHAR*5	
FERR	66B	/INITILN/		INTEGER	
FREQ	0B	/INITILN/		REAL	
FREQA	4B	/INITILN/		REAL	50
FTOT	67B	/INITILN/		INTEGER	
IERR	1035B			INTEGER	
LINE	NONE		UNUSED/*S*	INTEGER	
N	1034B			INTEGER	
OLDFILE	1033B			INTEGER	
PFN	1036B			CHAR*7	
QUALITY	1B	/INITILN/		INTEGER	
QUIT	1030B			INTEGER	
RFLAG	3B	/INITILN/		REAL	
Y1	NONE		UNUSED/*S*	INTEGER	
Y2	NONE		UNUSED/*S*	INTEGER	

```
--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE------------------------VALUE

  FMAX     INTEGER                          50


--PROCEDURES--(LO=A)
 -NAME------TYPE--------ARGS------CLASS-----       -NAME------TYPE--------ARGS------CLASS-----

  DATAIN                    2       SUBROUTINE       LFREQ                       0       SUBROUTINE
  ERROR                     1       SUBROUTINE       MANIP                       2       SUBROUTINE
  GETLEN    INTEGER         1       FUNCTION         PF                          5       SUBROUTINE


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF       -LABEL-ADDRESS-----PROPERTIES----DEF

    100      21B                   30          500     570B      FORMAT        143
    200      47B                   42          600  INACTIVE   DO-TERM       146
    250     166B                   81         9090 *NO REFS*                   92
    300     246B                  114         9091 *NO REFS*                  100
    400     260B                  120


--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  SFREQ      14B     0


--I/O UNITS--(LO=A)
 -NAME--- PROPERTIES-------------

  TAPE1   FMT/SEQ
  TAPE6   AUX/FMT/SEQ


--STATISTICS--

  PROGRAM-UNIT LENGTH          1040B =  544
  CM LABELLED COMMON LENGTH      71B =  57
  CM STORAGE USED             63000B =  26112
  COMPILE TIME                0.260 SECONDS

      1  WARNING   ERROR IN  SFREQ
```

```
      SUBROUTINE DATAIN (INSERT,LINE)                                 SFREQ   148
************************************************************************COMF    1
*** COMMON FOR INITIAL PARAMETERS                                    ***COMF    2
************************************************************************COMF    3
      INTEGER FMAX                                                    COMF      4
      PARAMETER (FMAX = 50)                                           COMF      5
      COMMON /INITILN/ FREQ, QUALITY, AFLAG, RFLAG, FREQA(FMAX), FERR,  COMF    6
     $                  FTOT                                          COMF      7
      COMMON /INITILC/ BLDG                                           COMF      8
      CHARACTER * 5 BLDG                                              COMF      9
      REAL FREQ, AFLAG, RFLAG, FREQA                                  COMF     10
      INTEGER QUALITY, FERR, FTOT                                     COMF     11
************************************************************************COMF   12
************************************************************************COMF   13
      INTEGER INSERT,LINE                                             SFREQ   150
      IF(INSERT.EQ.1) THEN                                            SFREQ   151
 200  PRINT *, ' ENTER FREQUENCY FOR LINE #',LINE                     SFREQ   152
300   READ(1,*,END=200,ERR=200) FREQA(LINE)                           SFREQ   153
      ENDIF                                                           SFREQ   154
      IF(INSERT.EQ.0) THEN                                            SFREQ   155
 400  PRINT *, 'ENTER NEXT FREQS, ONE PER LINE AFTER' ,               SFREQ   156
     + ' EACH QUESTION MARK.'                                         SFREQ   157
      PRINT *, ' ENTER ZERO (0.0) TO DISCONTINUE ENTRIES'             SFREQ   158
      PRINT *, 'START WITH LINE NUMBER = ', LINE                      SFREQ   159
  500 REWIND 1                                                        SFREQ   160
      READ(1,*,END=400,ERR=400) FREQA(LINE)                           SFREQ   161
      IF(FREQA(LINE).GT.0.0) THEN                                     SFREQ   162
*******************************************************               SFREQ   163
*  CHECK IF ARRAY SIZE EXCEEDED                                       SFREQ   164
*******************************************************               SFREQ   165
      IF( LINE.GT.FMAX) THEN                                          SFREQ   166
      PRINT *, 'MAXIMUM NUMBER OF DATA LINES CANNOT '                 SFREQ   167
      PRINT *, 'EXCEED ', FMAX, '. INSERTION NOT POSSIBLE.'           SFREQ   168
      RETURN                                                          SFREQ   169
      ENDIF                                                           SFREQ   170
*******************************************************               SFREQ   171
      LINE = LINE + 1                                                 SFREQ   172
      GOTO 500                                                        SFREQ   173
      ELSE                                                            SFREQ   174
      LINE =LINE -1                                                   SFREQ   175
      ENDIF                                                           SFREQ   176
      ENDIF                                                           SFREQ   177
      RETURN                                                          SFREQ   178
      END                                                             SFREQ   179
```

```
--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  AFLAG       2B  /INITILN/                  REAL
  BLDG        0B  /INITILC/                  CHAR*5
  FERR       66B  /INITILN/                  INTEGER
  FREQ        0B  /INITILN/                  REAL
  FREQA       4B  /INITILN/                  REAL           50
  FTOT       67B  /INITILN/                  INTEGER
  INSERT      1   DUMMY-ARG                  INTEGER
  LINE        2   DUMMY-ARG                  INTEGER
  QUALITY     1B  /INITILN/                  INTEGER
  RFLAG       3B  /INITILN/                  REAL
```

```
--SYMBOLIC CONSTANTS--(LO=A)
-NAME----TYPE------------------------VALUE

 FMAX    INTEGER                          50


--STATEMENT LABELS--(LO=A)
-LABEL-ADDRESS-----PROPERTIES----DEF

   200     12B                     17
   300 *NO REFS*                   18
   400     25B                     21
   500     33B                     25


--ENTRY POINTS--(LO=A)
-NAME---ADDRESS--ARGS---

 DATAIN      5B     2


--I/O UNITS--(LO=A)
-NAME--- PROPERTIES-------------

 TAPE1   FMT/SEQ


--STATISTICS--

 PROGRAM-UNIT LENGTH            200B =  128
 CM LABELLED COMMON LENGTH       71B =  57
 CM STORAGE USED              61000B =  25088
 COMPILE TIME                 0.073 SECONDS
```

```
      SUBROUTINE MANIP (QUIT,ABORT)                                     SFREQ    180
************************************************************************COMF       1
*** COMMON FOR INITIAL PARAMETERS                                    ***COMF       2
************************************************************************COMF       3
      INTEGER FMAX                                                      COMF       4
      PARAMETER (FMAX = 50)                                             COMF       5
      COMMON /INITILN/ FREQ, QUALITY, AFLAG, RFLAG, FREQA(FMAX), FERR,  COMF       6
     $                 FTOT                                             COMF       7
      COMMON /INITILC/ BLDG                                             COMF       8
      CHARACTER * 5 BLDG                                                COMF       9
      REAL FREQ, AFLAG, RFLAG, FREQA                                    COMF      10
      INTEGER QUALITY, FERR, FTOT                                       COMF      11
************************************************************************COMF      12
************************************************************************COMF      13
      INTEGER ABORT,ANSWER,DOK,FLAG1,LOK,N,NOK,OK,OK1,OK2,QUIT,INSERT   SFREQ    182
      INTEGER TEMP,V,X,Y,COMMAND                                        SFREQ    183
      CHARACTER * 3 DIR, FROM, TO                                       SFREQ    184
*                                                                       SFREQ    185
 10   FLAG1 = 0                                                         SFREQ    186
      PRINT*                                                            SFREQ    187
      PRINT*, 'CHOOSE'                                                  SFREQ    188
      PRINT*, '   (1) DISPLAY LINE OF DATA  (4) DISPLAY ALL LINES'      SFREQ    189
      PRINT*, '   (2) INSERT LINE INTO FILE (5) APPEND LINES OF DATA'   SFREQ    190
      PRINT*, '   (3) DELETE LINE           (6) STORE DATA AND EXIT ',  SFREQ    191
     +        'PROGRAM'                                                 SFREQ    192
      PRINT*, '                             (7) EXIT PROGRAM WITHOUT ', SFREQ    193
     +        'STORING DATA'                                            SFREQ    194
      PRINT*, 'ENTER A NUMBER !!!'                                      SFREQ    195
      PRINT*                                                            SFREQ    196
      REWIND 1                                                          SFREQ    197
      READ(1,*,END=10) COMMAND                                          SFREQ    198
*                                                                       SFREQ    199
*---------------------------------------------------------------------- SFREQ    200
*** DISPLAY LINE ***                                                    SFREQ    201
*---------------------------------------------------------------------- SFREQ    202
      IF ( COMMAND .EQ. 1 ) THEN                                        SFREQ    203
*                                                                       SFREQ    204
*** INDICATE EMPTY DATA FILE                                            SFREQ    205
        IF ( FTOT .EQ. 0 ) THEN                                         SFREQ    206
          PRINT*                                                        SFREQ    207
          PRINT*, 'DATA FILE IS EMPTY !!!'                              SFREQ    208
*                                                                       SFREQ    209
*** ENTER NUMBER OF LINE TO BE DISPLAYED                                SFREQ    210
        ELSE                                                            SFREQ    211
 100      PRINT*                                                        SFREQ    212
          PRINT*, 'SPECIFY THE NUMBER OF THE LINE TO BE DISPLAYED'      SFREQ    213
          PRINT*, '     ( ENTER "0" TO ESCAPE DISPLAY MODE )'           SFREQ    214
          REWIND 1                                                      SFREQ    215
          READ(1,*,END=100) N                                           SFREQ    216
*                                                                       SFREQ    217
*** CHECK VALIDITY OF LINE NUMBER                                       SFREQ    218
          IF ( (N .GT. FTOT) .OR. (N .LT. 0) ) THEN                     SFREQ    219
            PRINT*                                                      SFREQ    220
            PRINT*, 'INCORRECT NUMBER !!!!!!       TRY AGAIN !!!'       SFREQ    221
            PRINT*, '            -OR-  ENTER "0" TO ESCAPE FROM ',      SFREQ    222
     +              '"DISPLAY" MODE'                                    SFREQ    223
            GOTO 100                                                    SFREQ    224
*                                                                       SFREQ    225
*** ABORT 'DISPLAY' MODE                                                SFREQ    226
          ELSE IF ( N .EQ. 0 ) THEN                                     SFREQ    227
            PRINT*                                                      SFREQ    228
            PRINT*, '    "DISPLAY" MODE ABORTED !!!'                    SFREQ    229
*                                                                       SFREQ    230
*** DISPLAY LINE OF DATA                                                SFREQ    231
```

```
          ELSE IF ( (N .GT. 0) .AND. (N .LE. FTOT) ) THEN
            PRINT*
            CALL DISPLAY( N, COMMAND)
*
          END IF
        END IF
      END IF
*
*-------------------------------------------------------------------
*** INSERT LINE ***
*-------------------------------------------------------------------
      IF ( COMMAND .EQ. 2 ) THEN
*
*** INDICATE EMPTY DATA FILE
        IF ( FTOT .EQ. 0 ) THEN
          PRINT*
          PRINT*, 'DATA FILE IS EMPTY !!!'
*
*** REQUEST NUMBER OF LINE BEFORE WHICH INSERTION IS TO BE MADE
        ELSE
200       PRINT*
          PRINT*, 'SPECIFY NUMBER OF LINE BEFORE WHICH A NEW LINE IS ',
     +            'TO BE INSERTED'
          PRINT*, '     ( ENTER "0" TO ESCAPE "INSERTION" MODE )'
          REWIND 1
          READ(1,*,END=200) N
*
*** CHECK FOR VALID LINE NUMBER
          IF ( ( N .LT. 0 ) .OR. ( N .GT. FTOT ) ) THEN
            PRINT*
            PRINT*, 'INCORRECT LINE NUMBER !!!'
            PRINT*, '      TRY AGAIN !!!  -OR-  ENTER "0" TO ESCAPE',
     +              '"INSERTION" MODE'
            GOTO 200
*
*** ABORT INSERTION MODE
          ELSE IF ( N .EQ. 0 ) THEN
            PRINT*
            PRINT*, '       "INSERTION" MODE ABORTED'
*
*** MAKE ROOM FOR NEW LINE OF DATA
          ELSE IF ( (N .GT. 0) .AND. (N .LE. FTOT) ) THEN
*********************************************************
*  CHECK IF ARRAY SIZE EXCEEDED
*********************************************************
      IF( FTOT.EQ.FMAX) THEN
      PRINT *, 'MAXIMUM NUMBER OF DATA LINES CANNOT '
      PRINT *, 'EXCEED ', FMAX, '. INSERTION NOT POSSIBLE.'
      GO TO 10
      ENDIF
*********************************************************
            DO 230 X = FTOT,N,-1
                FREQA(X+1) = FREQA(X)
210           CONTINUE
230         CONTINUE
*
*** ENTER DATA FOR NEW LINE
            FTOT = FTOT + 1
            CALL DATAIN (1,N)
*
              PRINT*
              PRINT*, 'THE FOLLOWING LINE HAS BEEN ADDED AS LINE ', N
              CALL DISPLAY( N, COMMAND)
          END IF
```

```
            END IF
          END IF
*
*-------------------------------------------------------------------
*** DELETE LINE ***
*-------------------------------------------------------------------
          IF ( COMMAND .EQ. 3 ) THEN
*
*** INDICATE EMPTY DATA FILE
            IF ( FTOT .EQ. 0 ) THEN
              PRINT*
              PRINT*, 'DATA FILE IS EMPTY !!!'
*
*** READ NUMBER OF LINE TO BE DELETED
            ELSE
300           PRINT*
              PRINT*, 'SPECIFY THE NUMBER OF THE LINE TO BE DELETED'
              PRINT*, '   (ENTER "0" TO ESCAPE DELETION MODE)'
              REWIND 1
              READ(1,*,END=300) N
*
*** CHECK VALIDITY OF LINE NUMBER
              IF ( (N .GT. FTOT ) .OR. ( N .LT. 0 ) ) THEN
                PRINT*
                PRINT*, ' INCORRECT NUMBER !!!'
                PRINT*, '    TRY AGAIN !!!  -OR-  ENTER "0" TO ESCAPE FROM',
     +                '"DELETE" MODE'
                GOTO 300
*
*** ABORT 'DELETE' MODE
              ELSE IF ( N .EQ. 0 ) THEN
                PRINT*, '  "DELETE" MODE ABORTED'
*
*** DOUBLE CHECK CHOICE OF LINE TO BE DELETED
              ELSE IF (( N .GT. 0 ) .AND. ( N .LE. FTOT )) THEN
                PRINT*
                PRINT*, 'DOUBLE CHECK !!!'
                PRINT*, '     DO YOU WANT TO DELETE THE FOLLOWING LINE?:'
                CALL DISPLAY( N, COMMAND)
305             PRINT*, '   ENTER (1) YES  OR   (2) NO'
                REWIND 1
                READ(1,*,END=305) ANSWER
*
*** DELETE LINE
                IF ( ANSWER .EQ. 1 ) THEN
                  DO 330 X = N, FTOT - 1
                     FREQA(X) = FREQA(X+1)
330               CONTINUE
                  FTOT = FTOT - 1
                  PRINT*
                  PRINT*, 'LINE # ',N,' DELETED'
                END IF
*
              END IF
            END IF
          END IF
*
*-------------------------------------------------------------------
*** DISPLAY ALL DATA ***
*-------------------------------------------------------------------
          IF ( COMMAND .EQ. 4 ) THEN
*
*** INDICATE EMPTY DATA FILE
            IF ( FTOT .EQ. 0 ) THEN
```

```
          PRINT*
          PRINT*, 'DATA FILE IS EMPTY !!!'
*
*** DISPLAY DATA
        ELSE
          PRINT*
          CALL DISPLAY( N, COMMAND)
*
        END IF
      END IF
*
*-----------------------------------------------------------------------
*** ADD DATA ***
*-----------------------------------------------------------------------
      IF ( COMMAND .EQ. 5 ) THEN
*
*** ENTER DATA
500     FTOT = FTOT + 1
*******************************************************
*  CHECK IF ARRAY SIZE EXCEEDED
*******************************************************
      IF( FTOT.EQ.FMAX) THEN
      PRINT *, 'MAXIMUM NUMBER OF DATA LINES CANNOT '
      PRINT *, 'EXCEED ', FMAX, '. INSERTION NOT POSSIBLE.'
      GO TO 10
      ENDIF
*******************************************************
        CALL DATAIN (0,FTOT)
510     PRINT*
        PRINT*, 'DO YOU WANT TO ENTER MORE DATA?   (1) YES  (2) NO'
        PRINT*, '   ENTER A NUMBER !!!'
        REWIND 1
        READ(1,*,END=510) ANSWER
*
*** CHECK VALIDITY OF NUMBER
        IF ( ( ANSWER .NE. 1 ) .AND. ( ANSWER .NE. 2 ) ) THEN
          GOTO 510
*
*** ENTER MORE DATA
        ELSE IF ( ANSWER .EQ. 1 ) THEN
          GOTO 500
*
*** DISCONTINUE DATA ENTRY
        ELSE IF ( ANSWER .EQ. 2 ) THEN
          PRINT*
          PRINT*, 'DATA ENTRY DISCONTINUED'
*
        END IF
      END IF
*
*-----------------------------------------------------------------------
*** STORE DATA AND PROGRAM ***
*-----------------------------------------------------------------------
      IF ( COMMAND .EQ. 6 ) THEN
 600    PRINT*
        PRINT*, 'DOUBLE CHECK !!!'
        PRINT*, '    DO YOU YOU WANT TO STORE THIS DATA AND END PROG'
        PRINT*, ' NOTE: STORING THIS DATA WILL WIPE OUT ANY OLD FILE '
        PRINT*, ' OF THE SAME NAME !!!'
        PRINT*, '        ENTER A NUMBER: (1) YES   (2) NO'
        REWIND 1
        READ(1,*,END=600) ANSWER
*
*** SET FLAG FOR STORING DATA IN THE MAIN PROGRAM
```

```
          IF ( ANSWER .EQ. 1 ) THEN
            QUIT = 1
            RETURN
*
*** ABORT 'STORING' MODE
          ELSE IF ( ANSWER .EQ. 2 ) THEN
            PRINT*
            PRINT*, '    "STORING" MODE DISCONTINUED'
*
*** CHECK VALIDITY OF ANSWER
          ELSE IF ( ( ANSWER .NE. 1 ) .AND. ( ANSWER .NE. 2 ) ) THEN
            GOTO 600
*
          END IF
        END IF
*
*----------------------------------------------------------------------
*** END PROGRAM WITHOUT STORING DATA ***
*----------------------------------------------------------------------
        IF ( COMMAND .EQ. 7 ) THEN
  700     PRINT*
          PRINT*, 'DOUBLE CHECK !!!'
          PRINT*, '     DO YOU WANT TO END THIS PROGRAM ',
     +            'WITHOUT STORING DATA?'
          PRINT*, '         ENTER A NUMBER: (1) YES    (2) NO'
          REWIND 1
          READ(1,*,END=700) ANSWER
*
*** SET FLAG FOR ABORTING PROGRAM IN THE MAIN PROGRAM
          IF ( ANSWER .EQ. 1 ) THEN
            ABORT = 1
            RETURN
*
*** ABORT 'STORING' MODE
          ELSE IF ( ANSWER .EQ. 2 ) THEN
            PRINT*
            PRINT*, '    "ABORTION" MODE DISCONTINUED'
*
*** CHECK VALIDITY OF ANSWER
          ELSE IF ( ( ANSWER .NE. 1 ) .AND. ( ANSWER .NE. 2 ) ) THEN
            GOTO 700
*
          END IF
        END IF
*
*----------------------------------------------------------------------
*** LOOP TO BEGINNING OF 'MANIP' SUBROUTINE
*----------------------------------------------------------------------
        GOTO 10
*
        END
```

--VARIABLE MAP--(LO=A)

-NAME---	ADDRESS--	BLOCK-----	PROPERTIES-------	TYPE---------	SIZE
ABORT	2	DUMMY-ARG		INTEGER	
AFLAG	2B	/INITILN/		REAL	
ANSWER	1364B			INTEGER	
BLDG	0B	/INITILC/		CHAR*5	
COMMAND	1370B			INTEGER	
DIR	NONE		UNUSED/*S*	CHAR*3	
DOK	NONE		UNUSED/*S*	INTEGER	
FERR	66B	/INITILN/		INTEGER	

```
  FLAG1     1365B                                INTEGER
  FREQ         0B  /INITILN/                     REAL
  FREQA        4B  /INITILN/                     REAL            50
  FROM      NONE              UNUSED/*S*         CHAR*3
  FTOT        67B  /INITILN/                     INTEGER
  INSERT    NONE              UNUSED/*S*         INTEGER
  LOK       NONE              UNUSED/*S*         INTEGER
  N         1366B                                INTEGER
  NOK       NONE              UNUSED/*S*         INTEGER
  OK        NONE              UNUSED/*S*         INTEGER
  OK1       NONE              UNUSED/*S*         INTEGER
  OK2       NONE              UNUSED/*S*         INTEGER
  QUALITY      1B  /INITILN/                     INTEGER
  QUIT         1   DUMMY-ARG                     INTEGER
  RFLAG        3B  /INITILN/                     REAL
  TEMP      NONE              UNUSED/*S*         INTEGER
  TO        NONE              UNUSED/*S*         CHAR*3
  V         NONE              UNUSED/*S*         INTEGER
  X         1367B                                INTEGER
  Y         NONE              UNUSED/*S*         INTEGER


--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE------------------------VALUE

  FMAX     INTEGER                         50


--PROCEDURES--(LO=A)
 -NAME------TYPE--------ARGS------CLASS-----

  DATAIN                  2      SUBROUTINE
  DISPLAY                 2      SUBROUTINE


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF       -LABEL-ADDRESS-----PROPERTIES----DEF

    10      7B                     19          305    325B                    168
   100     50B                     45          330  INACTIVE    DO-TERM       176
   200    133B                     85          500    413B                    210
   210 *NO REFS*                  118          510    427B                    221
   230  INACTIVE   DO-TERM        119          600    470B                    247
   300    256B                    144          700    542B                    277


--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  MANIP       5B     2


--I/O UNITS--(LO=A)
 -NAME--- PROPERTIES-------------

  TAPE1   FMT/SEQ
```

```
FTN 5.1+552        83/12/20. 11.52.59 PAGE    13
SUBROUTINE MANIP    74/175  OPT=0

--STATISTICS--

  PROGRAM-UNIT LENGTH              1375B =  765
  CM LABELLED COMMON LENGTH          71B =  57
  CM STORAGE USED                 63000B =  26112
  COMPILE TIME                    0.406 SECONDS
```

```
      1       SUBROUTINE DISPLAY (LINE, COMMAND)                                  SFREQ      475
      2 ************************************************************************COMF         1
      3 *** COMMON FOR INITIAL PARAMETERS                                    ***COMF         2
      4 ************************************************************************COMF         3
      5       INTEGER FMAX                                                        COMF         4
      6       PARAMETER (FMAX = 50)                                               COMF         5
      7       COMMON /INITILN/ FREQ, QUALITY, AFLAG, RFLAG, FREQA(FMAX), FERR,    COMF         6
      8      $                 FTOT                                               COMF         7
      9       COMMON /INITILC/ BLDG                                               COMF         8
     10       CHARACTER * 5 BLDG                                                  COMF         9
     11       REAL FREQ, AFLAG, RFLAG, FREQA                                      COMF        10
     12       INTEGER QUALITY, FERR, FTOT                                         COMF        11
     13 ************************************************************************COMF        12
     14 ************************************************************************COMF        13
     15       INTEGER LINE, COMMAND, N                                            SFREQ      477
     16 1000  FORMAT (1X,'LINE #      FREQUENCY (HZ)')                            SFREQ      478
     17 2000  FORMAT (4X,I3,8X,1PE15.5)                                           SFREQ      479
     18       PRINT 1000                                                          SFREQ      480
     19       IF ( COMMAND .EQ. 4 ) THEN                                          SFREQ      481
     20         DO 10 N = 1,FTOT                                                  SFREQ      482
     21           PRINT 2000, N,FREQA(N)                                          SFREQ      483
     22 10      CONTINUE                                                          SFREQ      484
     23       ELSE                                                                SFREQ      485
     24           PRINT 2000, LINE,FREQA(LINE)                                    SFREQ      486
     25       END IF                                                              SFREQ      487
     26       RETURN                                                              SFREQ      488
     27       END                                                                 SFREQ      489
```

```
--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  AFLAG       2B  /INITILN/                  REAL
  BLDG        0B  /INITILC/                  CHAR*5
  COMMAND     2   DUMMY-ARG                  INTEGER
  FERR       66B  /INITILN/                  INTEGER
  FREQ        0B  /INITILN/                  REAL
  FREQA       4B  /INITILN/                  REAL           50
  FTOT       67B  /INITILN/                  INTEGER
  LINE        1   DUMMY-ARG                  INTEGER
  N         100B                             INTEGER
  QUALITY     1B  /INITILN/                  INTEGER
  RFLAG       3B  /INITILN/                  REAL


--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE------------------------VALUE

  FMAX    INTEGER                        50


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

    10  INACTIVE   DO-TERM        22
  1000      51B    FORMAT         16
  2000      56B    FORMAT         17
```

```
FTN 5.1+552          83/12/20. 11.52.59 PAGE     15
SUBROUTINE DISPLAY  74/175  OPT=0

--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  DISPLAY     5B      2


--STATISTICS--

  PROGRAM-UNIT LENGTH              104B =  68
  CM LABELLED COMMON LENGTH         71B =  57
  CM STORAGE USED                61000B =  25088
  COMPILE TIME                   0.045 SECONDS
```

```
      1         INTEGER FUNCTION VAL(STRING)                    SFREQ   490
      2   C** RETURNS THE INTEGER VALUE OF A STRING.            SFREQ   491
      3         INTEGER NUMBER, X,L,EXP,DIGIT,GETLEN            SFREQ   492
      4         CHARACTER * (*) STRING                          SFREQ   493
      5         L = GETLEN(STRING)                              SFREQ   494
      6         NUMBER = 0                                      SFREQ   495
      7         DO 10 X = L,1,-1                                SFREQ   496
      8         EXP = L - X                                     SFREQ   497
      9         DIGIT = ICHAR(STRING(X:X)) - 16                 SFREQ   498
     10         NUMBER = NUMBER + DIGIT*10**EXP                 SFREQ   499
     11   10    CONTINUE                                        SFREQ   500
     12         VAL = NUMBER                                    SFREQ   501
     13         RETURN                                          SFREQ   502
     14         END                                             SFREQ   503
```

```
--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  DIGIT      76B                                 INTEGER
  EXP        75B                                 INTEGER
  L          74B                                 INTEGER
  NUMBER     72B                                 INTEGER
  STRING      1   DUMMY-ARG                      CHAR*(*)
  VAL        71B                                 INTEGER
  X          73B                                 INTEGER


--PROCEDURES--(LO=A)
 -NAME------TYPE--------ARGS------CLASS-----

  GETLEN    INTEGER       1      FUNCTION
  ICHAR     INTEGER       1      INTRINSIC


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

    10  INACTIVE   DO-TERM        11


--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  VAL         6B     1


--STATISTICS--

  PROGRAM-UNIT LENGTH           102B =  66
  CM STORAGE USED             61000B =  25088
  COMPILE TIME                0.039 SECONDS
```

```
      INTEGER FUNCTION GETLEN (STRING)
C
C DETERMINE LENGTH OF STRING EXCLUDING ANY BLANK PADDING
C
C
C ARGUMENT DEFINITIONS --
C   READ ARGUMENTS
C      STRING - STRING WHOSE LENGTH IS TO BE DETERMINED
C
      CHARACTER * (*) STRING
C
C FUNCTION PARAMETERS
      CHARACTER * 1 BLANK
      PARAMETER (BLANK = ' ')
C
C LOCAL VARIABLES
      INTEGER NEXT
C
C START WITH THE LAST CHARACTER AND FIND THE FIRST NON-BLANK
      DO 10 NEXT = LEN(STRING),1,-1
         IF (STRING(NEXT : NEXT) .NE. BLANK) THEN
            GETLEN = NEXT
            RETURN
         END IF
   10 CONTINUE
C
C ALL CHARACTERS ARE BLANKS
      GETLEN = 0
C
      RETURN
      END
```

```
--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  GETLEN     63B                             INTEGER
  NEXT       64B                             INTEGER
  STRING      1   DUMMY-ARG                  CHAR*(*)


--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE------------------------VALUE

  BLANK   CHAR*1                         ' '


--PROCEDURES--(LO=A)
 -NAME------TYPE--------ARGS------CLASS-----

  LEN       INTEGER        1      INTRINSIC


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

     10  INACTIVE   DO-TERM        25
```



```
--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  GETLEN      6B      1


--STATISTICS--

  PROGRAM-UNIT LENGTH            70B =  56
  CM STORAGE USED             61000B =  25088
  COMPILE TIME                0.039 SECONDS
```

```
      SUBROUTINE LFREQ                                                  LFREQ        1
*!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!LFREQ        2
*!!!                                                                 !!!LFREQ        3
*!!!   LOAD THE CONTENTS OF THE FILE 'BXXXXXF' INTO ARRAYS FREQA.       LFREQ        4
*!!!                                                                 !!!LFREQ        5
*!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!LFREQ        6
************************************************************************LFREQ        7
***********************************************************************COMF         1
*** COMMON FOR INITIAL PARAMETERS                                   ***COMF         2
***********************************************************************COMF         3
      INTEGER FMAX                                                     COMF         4
      PARAMETER (FMAX = 50)                                            COMF         5
      COMMON /INITILN/ FREQ, QUALITY, AFLAG, RFLAG, FREQA(FMAX), FERR,  COMF         6
     $                  FTOT                                           COMF         7
      COMMON /INITILC/ BLDG                                            COMF         8
      CHARACTER * 5 BLDG                                               COMF         9
      REAL FREQ, AFLAG, RFLAG, FREQA                                   COMF        10
      INTEGER QUALITY, FERR, FTOT                                      COMF        11
***********************************************************************COMF        12
***********************************************************************COMF        13
**************************************************                      LFREQ        9
*   DECLARATION OF VARIABLES                                            LFREQ       10
**************************************************                      LFREQ       11
      INTEGER GETLEN, R, C                                              LFREQ       12
      CHARACTER * 7 NAME, PFN                                           LFREQ       13
**************************************************                      LFREQ       14
*                                                                       LFREQ       15
**************************************************                      LFREQ       16
      NAME = 'B'//BLDG(1:GETLEN(BLDG))//'F'                             LFREQ       17
      PFN = NAME (1:GETLEN(NAME))                                       LFREQ       18
      FERR = 0                                                          LFREQ       19
      CALL PF ('GET',0,PFN(1:GETLEN(PFN)),'RC',FERR)                    LFREQ       20
      IF ( FERR .EQ. 0 ) THEN                                           LFREQ       21
        OPEN (UNIT=3, FILE=PFN, FORM='FORMATTED',                       LFREQ       22
     $        STATUS='OLD', ACCESS='SEQUENTIAL')                        LFREQ       23
        FTOT = 0                                                        LFREQ       24
        DO 10 R = 1,FMAX                                                LFREQ       25
          READ (3,1000,END=20) FREQA(R)                                 LFREQ       26
 1000     FORMAT(E12.7)                                                 LFREQ       27
          FTOT = FTOT + 1                                               LFREQ       28
10      CONTINUE                                                        LFREQ       29
20      CONTINUE                                                        LFREQ       30
        CLOSE(3,STATUS='DELETE')                                        LFREQ       31
      ELSE IF ( FERR .EQ. 2 ) THEN                                      LFREQ       32
        CALL WARNING (11)                                               LFREQ       33
      ELSE                                                              LFREQ       34
        CALL WARNING (12)                                               LFREQ       35
      END IF                                                            LFREQ       36
      RETURN                                                            LFREQ       37
      END                                                               LFREQ       38
```

```
--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  AFLAG       2B  /INITILN/                  REAL
  BLDG        0B  /INITILC/                  CHAR*5
  C         NONE               UNUSED/*S*    INTEGER
  FERR       66B  /INITILN/                  INTEGER
  FREQ        0B  /INITILN/                  REAL
  FREQA       4B  /INITILN/                  REAL            50
  FTOT       67B  /INITILN/                  INTEGER
  NAME      210B                             CHAR*7
  PFN       211B                             CHAR*7
```

```
 QUALITY      1B  /INITILN/                INTEGER
 R          207B                           INTEGER
 RFLAG        3B  /INITILN/                REAL


--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE------------------------VALUE

  FMAX    INTEGER                       50


--PROCEDURES--(LO=A)
 -NAME------TYPE--------ARGS------CLASS-----

  GETLEN    INTEGER         1      FUNCTION
  PF                        5      SUBROUTINE
  WARNING                   1      SUBROUTINE


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

     10  INACTIVE   DO-TERM        41
     20     63B                    42
   1000    120B     FORMAT         39


--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  LFREQ      5B     0


--I/O UNITS--(LO=A)
 -NAME--- PROPERTIES-------------

  TAPE3   AUX/FMT/SEQ


--STATISTICS--

  PROGRAM-UNIT LENGTH            215B =  141
  CM LABELLED COMMON LENGTH       71B =  57
  CM STORAGE USED              61000B =  25088
  COMPILE TIME                 0.080 SECONDS
```

```
      SUBROUTINE ERROR(IERR)                                            ERROR      1
      CHARACTER*45 MESSAGE(20)                                          ERROR      2
      DATA MESSAGE( 1)/'MATERIALS DATA BASE IS EMPTY                 '/ ERROR      3
      DATA MESSAGE( 2)/'FREQUENCY IS OUT OF RANGE                    '/ ERROR      4
      DATA MESSAGE( 3)/'THIS MATERIAL IS NOT IN DATA BASE            '/ ERROR      5
      DATA MESSAGE( 4)/'DENOMINATOR IS ZERO                          '/ ERROR      6
      DATA MESSAGE( 5)/'FILE HANDLING ERROR                          '/ ERROR      7
      DATA MESSAGE( 6)/'ERROR CODE IS OUT OF RANGE                   '/ ERROR      8
      DATA MESSAGE( 7)/'ERROR CODE IS OUT OF RANGE                   '/ ERROR      9
      DATA MESSAGE( 8)/'ERROR CODE IS OUT OF RANGE                   '/ ERROR     10
      DATA MESSAGE( 9)/'ERROR CODE IS OUT OF RANGE                   '/ ERROR     11
      DATA MESSAGE(10)/'ERROR CODE IS OUT OF RANGE                   '/ ERROR     12
      DATA MESSAGE(11)/'ERROR CODE IS OUT OF RANGE                   '/ ERROR     13
      DATA MESSAGE(12)/'ERROR CODE IS OUT OF RANGE                   '/ ERROR     14
      DATA MESSAGE(13)/'ERROR CODE IS OUT OF RANGE                   '/ ERROR     15
      DATA MESSAGE(14)/'ERROR CODE IS OUT OF RANGE                   '/ ERROR     16
      DATA MESSAGE(15)/'ERROR CODE IS OUT OF RANGE                   '/ ERROR     17
      DATA MESSAGE(16)/'ERROR CODE IS OUT OF RANGE                   '/ ERROR     18
      DATA MESSAGE(17)/'ERROR CODE IS OUT OF RANGE                   '/ ERROR     19
      DATA MESSAGE(18)/'ERROR CODE IS OUT OF RANGE                   '/ ERROR     20
      DATA MESSAGE(19)/'ERROR CODE IS OUT OF RANGE                   '/ ERROR     21
      DATA MESSAGE(20)/'ERROR CODE IS OUT OF RANGE                   '/ ERROR     22
      IERRM=5                                                           ERROR     23
      IF(IERR.GT.IERRM) IERR=20                                         ERROR     24
      WRITE(6,10) IERR,MESSAGE(IERR)                                    ERROR     25
   10 FORMAT(' ***ERROR NUMBER = ',I5,' ***  ',A45)                     ERROR     26
      CALL PMDSTOP                                                      ERROR     27
      STOP 'ERROR'                                                      ERROR     28
      END                                                               ERROR     29
```

```
--VARIABLE MAP--(LO=A)
-NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

 IERR        1   DUMMY-ARG                  INTEGER
 IERRM     210B                             INTEGER
 MESSAGE    56B                             CHAR*45        20


--PROCEDURES--(LO=A)
-NAME------TYPE--------ARGS------CLASS-----

 PMDSTOP                  0      SUBROUTINE


--STATEMENT LABELS--(LO=A)
-LABEL-ADDRESS-----PROPERTIES----DEF

   10     36B      FORMAT          26


--ENTRY POINTS--(LO=A)
-NAME---ADDRESS--ARGS---

 ERROR       5B      1
```

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SUBROUTINE ERROR 74/175 OPT=0

```
--I/O UNITS--(LO=A)
-NAME--- PROPERTIES-------------

 TAPE6   FMT/SEQ


--STATISTICS--

 PROGRAM-UNIT LENGTH          213B =   139
 CM STORAGE USED            61000B = 25088
 COMPILE TIME               0.056 SECONDS
```

```
      SUBROUTINE WARNING(ERR)                                          WARNING     1
      INTEGER ERR, ERRM                                                WARNING     2
      CHARACTER*45 MESSAGE(20)                                         WARNING     3
      DATA MESSAGE( 1)/'"HOLE" DATA FILE DOES NOT EXIST FOR THIS BLDG'/ WARNING    4
      DATA MESSAGE( 2)/'FILE HANDLING PROBLEM ON "HOLE" DATA FILE    '/ WARNING    5
      DATA MESSAGE( 3)/'"MATTER" FILE DOES NOT EXIST FOR THIS BLDG   '/ WARNING    6
      DATA MESSAGE( 4)/'FILE HANDLING PROBLEM ON "MATTER FILE        '/ WARNING    7
      DATA MESSAGE( 5)/'"TYPE" DATA FILE DOES NOT EXIST FOR THIS BLDG'/ WARNING    8
      DATA MESSAGE( 6)/'FILE HANDLING PROBLEM ON "TYPE" FILE         '/ WARNING    9
      DATA MESSAGE( 7)/'"WALL" DATA FILE DOES NOT EXIST FOR THIS BLDG'/ WARNING   10
      DATA MESSAGE( 8)/'FILE HANDLING PROBLEM ON "WALL" FILE         '/ WARNING   11
      DATA MESSAGE( 9)/'HEIGHT AND WIDTH OF ROOM MISSING             '/ WARNING   12
      DATA MESSAGE(10)/'LENGTH OF ROOM IS MISSING                    '/ WARNING   13
      DATA MESSAGE(11)/'FREQ FILE DOES NOT EXIST FOR THIS BLDG       '/ WARNING   14
      DATA MESSAGE(12)/'FILE HANDLING PROBLEM WITH FREQ FILE         '/ WARNING   15
      DATA MESSAGE(13)/'WARNING CODE IS OUT OF RANGE                 '/ WARNING   16
      DATA MESSAGE(14)/'WARNING CODE IS OUT OF RANGE                 '/ WARNING   17
      DATA MESSAGE(15)/'WARNING CODE IS OUT OF RANGE                 '/ WARNING   18
      DATA MESSAGE(16)/'WARNING CODE IS OUT OF RANGE                 '/ WARNING   19
      DATA MESSAGE(17)/'WARNING CODE IS OUT OF RANGE                 '/ WARNING   20
      DATA MESSAGE(18)/'WARNING CODE IS OUT OF RANGE                 '/ WARNING   21
      DATA MESSAGE(19)/'WARNING CODE IS OUT OF RANGE                 '/ WARNING   22
      DATA MESSAGE(20)/'WARNING CODE IS OUT OF RANGE                 '/ WARNING   23
      ERRM=12                                                          WARNING    24
      IERR = ERR                                                       WARNING    25
      IF(ERR.GT.ERRM) IERR=20                                          WARNING    26
      WRITE(6,20)                                                      WARNING    27
      WRITE(6,10) ERR,MESSAGE(IERR)                                    WARNING    28
      WRITE(6,20)                                                      WARNING    29
 10   FORMAT(' ***WARNING NUMBER = ',I5,' ***  ',A45)                  WARNING    30
 20   FORMAT('      ')                                                 WARNING    31
      RETURN                                                           WARNING    32
      END                                                              WARNING    33
```

```
--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  ERR          1   DUMMY-ARG                 INTEGER
  ERRM       60B                             INTEGER
  IERR      213B                             INTEGER
  MESSAGE    61B                             CHAR*45        20

--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

     10     34B     FORMAT          30
     20     42B     FORMAT          31

--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  WARNING     5B      1
```

```
FTN 5.1+552          83/12/20. 11.52.59 PAGE     24
SUBROUTINE WARNING  74/175  OPT=0

--I/O UNITS--(LO=A)
 -NAME--- PROPERTIES-------------

  TAPE6   FMT/SEQ

--STATISTICS--

  PROGRAM-UNIT LENGTH              216B =   142
  CM STORAGE USED                61000B = 25088
  COMPILE TIME                   0.064 SECONDS
```

Appendix 9.7 Listing of Computer Program MASTER

```
      PROGRAM MASTER (INPUT,OUTPUT, TAPE1 = INPUT,TAPE6 = OUTPUT)       MASTER      1
*************************************************************************MASTER      2
*************************************************************************COMF        1
*** COMMON FOR INITIAL PARAMETERS                                     ***COMF        2
*************************************************************************COMF        3
      INTEGER FMAX                                                      COMF        4
      PARAMETER (FMAX = 50)                                             COMF        5
      COMMON /INITILN/ FREQ, QUALITY, AFLAG, RFLAG, FREQA(FMAX), FERR,  COMF        6
     $                 FTOT                                             COMF        7
      COMMON /INITILC/ BLDG                                             COMF        8
      CHARACTER * 5 BLDG                                                COMF        9
      REAL FREQ, AFLAG, RFLAG, FREQA                                    COMF       10
      INTEGER QUALITY, FERR, FTOT                                       COMF       11
*************************************************************************COMF       12
*************************************************************************COMF       13
*************************************************************************COMW        1
***   COMMON FOR DATABASE OF WALL PARAMETERS                          ***COMW        2
*************************************************************************COMW        3
      INTEGER WMAX                                                      COMW        4
      PARAMETER (WMAX = 75)                                             COMW        5
      COMMON /WALLN/ WDIM(WMAX,3), WTOT, WERR                           COMW        6
      COMMON /WALLC/ WALL(WMAX,4)                                       COMW        7
      INTEGER WTOT,WERR                                                 COMW        8
      REAL WDIM                                                         COMW        9
      CHARACTER *3 WALL                                                 COMW       10
* ==================================                                    COMW       11
** DESCRIPTION OF ARRAYS                                                COMW       12
* ==================================                                    COMW       13
*    WALL IDENTIFICATION                                                COMW       14
* ----------------------------------                                    COMW       15
* DIRECTION    FROM       TO                                            COMW       16
*              ROOM       ROOM                                          COMW       17
* ----------------------------------                                    COMW       18
* WALL(X,1)   WALL(X,2)   WALL(X,3)                                     COMW       19
*  A3          A3          A3                                           COMW       20
* ========================================================              COMW       21
*        WALL PARAMETERS                                                COMW       22
* --------------------------------------------------------              COMW       23
* MATERIAL    HEIGHT      WIDTH       LAYER THICKNESS                   COMW       24
* --------------------------------------------------------              COMW       25
* WALL(X,4)   WDIM(X,1)   WDIM(X,2)   WDIM(X,3)                         COMW       26
*  A3         F8.2        F8.2        F8.2                              COMW       27
*************************************************************************COMW       28
*************************************************************************COMW       29
*************************************************************************COMT        1
***   COMMON FOR DATABASE OF TYPES OF DOORS AND WINDOWS               ***COMT        2
*************************************************************************COMT        3
      INTEGER TMAX                                                      COMT        4
      PARAMETER (TMAX=35)                                               COMT        5
      COMMON /TYPEN/TDIM(TMAX,4),TTOT,TDB2(TMAX,2),TDBTOT,TERR          COMT        6
      COMMON /TYPEC/TYPE(TMAX,3),TDB1(TMAX)                             COMT        7
      INTEGER TTOT,TDBTOT,TERR                                          COMT        8
      REAL TDIM,TDB2                                                    COMT        9
      CHARACTER * 3 TYPE,TDB1                                           COMT       10
*================================================                       COMT       11
* DESCRIPTION OF ARRAYS                                                 COMT       12
*================================================                       COMT       13
*   ID        MATERIAL    FRAME MATERIAL                                COMT       14
*-----------------------------------------------                        COMT       15
*TYPE(X,1)   TYPE(X,2)   TYPE(X,3)                                     COMT       16
* A3          A3          A3                                            COMT       17
*================================================                       COMT       18
* HEIGHT      WIDTH       LAYER       DISTANCE                          COMT       19
*                         THICKNESS   ABOVE FLOOR                       COMT       20
```

```
*---------------------------------------------------                COMT      21
* TDIM(X,1)   TDIM(X,2)   TDIM(X,3)   TDIM(X,4)                     COMT      22
*  F8.2        F8.2        F8.2        F8.2                         COMT      23
*===================================================                COMT      24
*  ID       ATTENUATION    AREA                                     COMT      25
* --------------------------------------------------                COMT      26
* TDB1(X)    TDB2(X,1)    TDB2(X,2)                                 COMT      27
*   A3          E9.3         E9.3                                   COMT      28
************************************************************************COMT      29
************************************************************************COMT      30
************************************************************************COMH       1
***   COMMON FOR DATABASE OF LOCATIONS OF DOORS AND WINDOWS          ***COMH       2
************************************************************************COMH       3
      INTEGER HMAX                                                  COMH       4
      PARAMETER (HMAX = 35)                                         COMH       5
      COMMON /HOLEN/ HTOT, HERR                                     COMH       6
      COMMON /HOLEC/ HOLE(HMAX,4)                                   COMH       7
      INTEGER HTOT, HERR                                            COMH       8
      CHARACTER * 3 HOLE                                            COMH       9
* ==================================================                COMH      10
* DESCRIPTION OF ARRAYS                                             COMH      11
* ==================================================                COMH      12
*     ROOM IDENTIFICATION              APERTURE ID                  COMH      13
* ------------------------------------                              COMH      14
* DIRECTION    FROM ROOM     TO ROOM                                COMH      15
* --------------------------------------------------                COMH      16
* HOLE(X,1)    HOLE(X,2)     HOLE(X,3)    HOLE(X,4)                 COMH      17
*   A3            A3            A3            A3                    COMH      18
************************************************************************COMH      19
************************************************************************COMH      20
************************************************************************COMR       1
***   COMMON FOR ROOM ARRAY CONTAINING ATTENUATION OF WALLS          ***COMR       2
************************************************************************COMR       3
      INTEGER RMAX                                                  COMR       4
      PARAMETER (RMAX = 20)                                         COMR       5
      COMMON /ROOMN/ ROOM(RMAX + 6, RMAX + 6), NROOMS, RAREA(RMAX)      COMR       6
      INTEGER NROOMS                                                COMR       7
      REAL ROOM                                                     COMR       8
************************************************************************COMR       9
************************************************************************COMR      10
************************************************************************COMM       1
***   COMMON FOR DATABASE OF MATERIAL PROPERTIES                     ***COMM       2
************************************************************************COMM       3
      INTEGER MMAX                                                  COMM       4
      PARAMETER (MMAX=100)                                          COMM       5
      COMMON /MATN/ MATTEN(MMAX,7), MRCOEF(MMAX,7), QA(MMAX), QR(MMAX), COMM       6
     $              MFREQ(MMAX,7), MERR, MTOT                       COMM       7
      COMMON /MATC/MAT(MMAX),MATDESC(MMAX)                          COMM       8
      INTEGER MTOT, MERR                                            COMM       9
      REAL MATTEN, MRCOEF, MFREQ, QA, QR                            COMM      10
      CHARACTER * 3  MAT                                            COMM      11
      CHARACTER * 70 MATDESC                                        COMM      12
************************************************************************COMM      13
************************************************************************COMM      14
*****************************************************************   COMJ       1
*                                                                   COMJ       2
* COMMON FOR EVALUATION OF ROOM MATRIX                              COMJ       3
*                                                                   COMJ       4
*****************************************************************   COMJ       5
      COMMON /MAT/TMAT(RMAX,RMAX),ENERGY(RMAX),POWER(6),FTIME       COMJ       6
     +,SWR(RMAX,6),IDIR                                             COMJ       7
      REAL TMAT ,ENERGY,POWER,SWR                                   COMJ       8
      LOGICAL FTIME                                                 COMJ       9
************************************************************************COMD       1
```

```
*     COMMON FOR ABSORPTION AND REFLECTION COEFFICIENTS IN WALLS        COMD       2
**********************************************************************COMD       3
      COMMON /ROOMD/DDABS(RMAX + 6, RMAX + 6 ) ,DREFL, DREFLW           COMD       4
      REAL DDABS ,DREFL , DREFLW                                        COMD       5
**********************************************************************COMD       6
**********************************************************************COMD       7
****************************************************                    MASTER    11
*   DECLARATION OF VARIABLES                                            MASTER    12
****************************************************                    MASTER    13
      INTEGER GETLEN                                                    MASTER    14
****************************************************                    MASTER    15
*   INITIAL SETUP                                                       MASTER    16
****************************************************                    MASTER    17
      NROOMS = 3                                                        MASTER    18
      AFLAG = 0                                                         MASTER    19
      RFLAG = 0                                                         MASTER    20
****************************************************                    MASTER    21
*   INPUT BUILDING IDENTIFICATION                                       MASTER    22
****************************************************                    MASTER    23
   20 PRINT*, 'ENTER BUILDING IDENTIFICATION  (E.G. ''101'')'          MASTER    24
      PRINT*, '    (NO MORE THAN 5 ALPHANUMERIC CHARACTERS)'            MASTER    25
      READ(1, * , END = 20) BLDG                                        MASTER    26
      PRINT*, 'BUILDING IDENTIFICATION ENTERED AS ''',                  MASTER    27
     $         BLDG(1:GETLEN(BLDG)), ''''                               MASTER    28
 30   PRINT *, 'ENTER NUMBER OF ROOMS IN BUILDING'                      MASTER    29
      READ (1,*,END = 30) NROOMS                                        MASTER    30
****************************************************                    MASTER    31
*   LOAD ARRAYS FROM DATA FILES                                         MASTER    32
****************************************************                    MASTER    33
      CALL LMATTER                                                      MASTER    34
      CALL LWALL                                                        MASTER    35
      CALL LTYPE                                                        MASTER    36
      CALL LHOLE                                                        MASTER    37
      CALL LFREQ                                                        MASTER    38
****************************************************                    MASTER    39
*  CHECK FOR ERROR IN FREQ FILE.                                        MASTER    40
*  IF THERE IS AN ERROR (E.G. MISSING) THEN                             MASTER    41
*  JUST USE THE DEFAULT FREQUENCIES                                     MASTER    42
****************************************************                    MASTER    43
      IF (FERR.NE.0) THEN                                               MASTER    44
        FTOT = 7                                                        MASTER    45
        DO 40 IFR = 1,7                                                 MASTER    46
   40   FREQA(IFR) = 1.0E03 * (10.0 ** IFR)                             MASTER    47
        PRINT*, ' *** DEFAULT FREQUENCIES WILL BE USED *** '            MASTER    48
      ENDIF                                                             MASTER    49
*************************************************************           MASTER    50
      CALL PWALL                                                        MASTER    51
      CALL PHOLE                                                        MASTER    52
      CALL PTYPE                                                        MASTER    53
****************************************************                    MASTER    54
*   CHECK FOR FILE ERROR                                                MASTER    55
****************************************************                    MASTER    56
      IF ( ( MERR .NE. 0 ) .OR. ( WERR .NE. 0 ) .OR.                    MASTER    57
     $     ( HERR .NE. 0 ) .OR. (TERR .NE. 0 ) ) THEN                   MASTER    58
        CALL ERROR (5)                                                  MASTER    59
      END IF                                                            MASTER    60
****************************************************                    MASTER    61
*                                                                       MASTER    62
****************************************************                    MASTER    63
      DO 200 IFR= 1,FTOT                                                MASTER    64
      FREQ = FREQA(IFR)                                                 MASTER    65
      CALL IDDABS                                                       MASTER    66
      CALL LTDB                                                         MASTER    67
      CALL LRAREA                                                       MASTER    68
```

```
          CALL CFACTOR                                               MASTER      69
          CALL DFACTOR                                               MASTER      70
          FTIME = .TRUE.                                             MASTER      71
          DO 100 IDIR = 1 , 5                                        MASTER      72
          DO 50 J = 1 , 6                                            MASTER      73
       50 POWER (J) = 0.0                                            MASTER      74
          POWER (IDIR) = 10.0                                        MASTER      75
          CALL ECALC                                                 MASTER      76
      100 CALL SPWR                                                  MASTER      77
          CALL PPWR2                                                 MASTER      78
      200 CONTINUE                                                   MASTER      79
          STOP                                                       MASTER      80
          END                                                        MASTER      81


--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  AFLAG       2B  /INITILN/                  REAL
  BLDG        0B  /INITILC/                  CHAR*5
  DDABS       0B  /ROOMD/                    REAL           676
  DREFL    1244B  /ROOMD/                    REAL
  DREFLW   1245B  /ROOMD/                    REAL
  ENERGY    620B  /MAT/                      REAL            20
  FERR       66B  /INITILN/                  INTEGER
  FREQ        0B  /INITILN/                  REAL
  FREQA       4B  /INITILN/                  REAL            50
  FTIME     652B  /MAT/                      LOGICAL
  FTOT       67B  /INITILN/                  INTEGER
  HERR        1B  /HOLEN/                    INTEGER
  HOLE        0B  /HOLEC/                    CHAR*3         140
  HTOT        0B  /HOLEN/                    INTEGER
  IDIR     1043B  /MAT/                      INTEGER
  IFR       332B                             INTEGER
  J         336B                             INTEGER
  MAT         0B  /MATC/                     CHAR*3         100
  MATDESC    36B  /MATC/                     CHAR*70        100
  MATTEN      0B  /MATN/                     REAL           700
  MERR     4374B  /MATN/                     INTEGER
  MFREQ    3100B  /MATN/                     REAL           700
  MRCOEF   1274B  /MATN/                     REAL           700
  MTOT     4375B  /MATN/                     INTEGER
  NROOMS   1244B  /ROOMN/                    INTEGER
  POWER     644B  /MAT/                      REAL             6
  QA       2570B  /MATN/                     REAL           100
  QR       2734B  /MATN/                     REAL           100
  QUALITY     1B  /INITILN/                  INTEGER
  RAREA    1245B  /ROOMN/                    REAL            20
  RFLAG       3B  /INITILN/                  REAL
  ROOM        0B  /ROOMN/                    REAL           676
  SWR       653B  /MAT/                      REAL           120
  TDBTOT    323B  /TYPEN/                    INTEGER
  TDB1       37B  /TYPEC/                    CHAR*3          35
  TDB2      215B  /TYPEN/                    REAL            70
  TDIM        0B  /TYPEN/                    REAL           140
  TERR      324B  /TYPEN/                    INTEGER
  TMAT        0B  /MAT/                      REAL           400
  TTOT      214B  /TYPEN/                    INTEGER
  TYPE        0B  /TYPEC/                    CHAR*3         105
  WALL        0B  /WALLC/                    CHAR*3         300
  WDIM        0B  /WALLN/                    REAL           225
  WERR      342B  /WALLN/                    INTEGER
  WTOT      341B  /WALLN/                    INTEGER
```

```
--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE------------------------VALUE      -NAME----TYPE------------------------VALUE

  FMAX    INTEGER                          50      RMAX    INTEGER                          20
  HMAX    INTEGER                          35      TMAX    INTEGER                          35
  MMAX    INTEGER                         100      WMAX    INTEGER                          75


--PROCEDURES--(LO=A)
 -NAME------TYPE--------ARGS------CLASS-----      -NAME------TYPE--------ARGS------CLASS-----

  CFACTOR                   0      SUBROUTINE       LRAREA                  0      SUBROUTINE
  DFACTOR                   0      SUBROUTINE       LTDB                    0      SUBROUTINE
  ECALC                     0      SUBROUTINE       LTYPE                   0      SUBROUTINE
  ERROR                     1      SUBROUTINE       LWALL                   0      SUBROUTINE
  GETLEN    INTEGER         1      FUNCTION         PHOLE                   0      SUBROUTINE
  IDDABS                    0      SUBROUTINE       PPWR2                   0      SUBROUTINE
  LFREQ                     0      SUBROUTINE       PTYPE                   0      SUBROUTINE
  LHOLE                     0      SUBROUTINE       PWALL                   0      SUBROUTINE
  LMATTER                   0      SUBROUTINE       SPWR                    0      SUBROUTINE


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF       -LABEL-ADDRESS-----PROPERTIES----DEF

    20      26B                    148          50  INACTIVE   DO-TERM       198
    30      44B                    153         100  INACTIVE   DO-TERM       201
    40  INACTIVE    DO-TERM        171         200  INACTIVE   DO-TERM       203


--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  MASTER     20B     0


--I/O UNITS--(LO=A)
 -NAME--- PROPERTIES-------------

  TAPE1   FMT/SEQ


--STATISTICS--

  PROGRAM-UNIT LENGTH            340B =  224
  CM LABELLED COMMON LENGTH    12774B =  5628
  CM STORAGE USED              63000B =  26112
  COMPILE TIME                 0.183 SECONDS
```

```
      REAL FUNCTION ATTEN (ID,FREQ,AFLAG)                               ATTEN        1
*[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[ATTEN        2
*[[[                                                                [[[ATTEN        3
*[[[  GIVEN THE FREQUENCY AND THE MATERIAL, THIS FUNCTION RETURNS   [[[ATTEN        4
*[[[  THE ATTENUATION                                               [[[ATTEN        5
*[[[                                                                [[[ATTEN        6
*[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[ATTEN        7
************************************************************************ATTEN        8
*   FREQ IS IN HERTZ                                                    ATTEN        9
*   HIFREQ,LOFREQ, AND F ARE IN LOG ( HERTZ )                           ATTEN       10
*   AFLAG RANGES FROM 0 TO 100 AND DETERMINES HOW MUCH OF THE QUALITY   ATTEN       11
*   FACTOR IS APPLIED TO THE ATTENUATION VALUE.                         ATTEN       12
************************************************************************ATTEN       13
************************************************************************COMM         1
***   COMMON FOR DATABASE OF MATERIAL PROPERTIES                     ***COMM         2
************************************************************************COMM         3
      INTEGER MMAX                                                      COMM         4
      PARAMETER (MMAX=100)                                              COMM         5
      COMMON /MATN/ MATTEN(MMAX,7), MRCOEF(MMAX,7), QA(MMAX), QR(MMAX), COMM         6
     $              MFREQ(MMAX,7), MERR, MTOT                           COMM         7
      COMMON /MATC/MAT(MMAX),MATDESC(MMAX)                              COMM         8
      INTEGER MTOT, MERR                                                COMM         9
      REAL MATTEN, MRCOEF, MFREQ, QA, QR                                COMM        10
      CHARACTER * 3  MAT                                                COMM        11
      CHARACTER * 70 MATDESC                                            COMM        12
************************************************************************COMM        13
************************************************************************COMM        14
**************************************************                      ATTEN       15
*   DECLARATION OF VARIABLES                                            ATTEN       16
**************************************************                      ATTEN       17
      REAL FREQ,FRAC,MINFREQ,MAXFREQ,LOFREQ,HIFREQ,LOATTEN,HIATTEN,F    ATTEN       18
      INTEGER R,C,RINDEX,CINDEX                                         ATTEN       19
      LOGICAL FOUND,EXACT                                               ATTEN       20
      CHARACTER *3 ID                                                   ATTEN       21
**************************************************                      ATTEN       22
*   FIND ROW INDEX OF MATERIAL                                          ATTEN       23
**************************************************                      ATTEN       24
      FOUND = .FALSE.                                                   ATTEN       25
      DO 10 R = 1, MMAX                                                 ATTEN       26
         IF ( MAT(R) .EQ. ID ) THEN                                     ATTEN       27
            FOUND = .TRUE.                                              ATTEN       28
            RINDEX = R                                                  ATTEN       29
         END IF                                                         ATTEN       30
10    CONTINUE                                                          ATTEN       31
      IF ( .NOT. FOUND ) THEN                                           ATTEN       32
         IERR = 3                                                       ATTEN       33
         CALL ERROR (IERR)                                              ATTEN       34
      END IF                                                            ATTEN       35
**************************************************                      ATTEN       36
*   TEST FOR FREQUENCY OUT OF RANGE                                     ATTEN       37
**************************************************                      ATTEN       38
      MINFREQ = MFREQ (RINDEX,1)                                        ATTEN       39
      MAXFREQ = MFREQ (RINDEX,7)                                        ATTEN       40
      IF ( FREQ .LT. MINFREQ .OR. FREQ .GT. MAXFREQ ) THEN              ATTEN       41
         IERR = 2                                                       ATTEN       42
         CALL ERROR (IERR)                                              ATTEN       43
      END IF                                                            ATTEN       44
**************************************************                      ATTEN       45
*   IF THE EXACT FREQUENCY IS IN THE TABLE, THEN                        ATTEN       46
*   USE THE ATTENUATION VALUE WITHOUT INTERPOLATION.                    ATTEN       47
**************************************************                      ATTEN       48
      DO 20 C= 1,7                                                      ATTEN       49
      EXACT = .FALSE.                                                   ATTEN       50
      IF ( FREQ .EQ. MFREQ (RINDEX,C) ) THEN                            ATTEN       51
```

```
            EXACT = .TRUE.
            CINDEX = C
            ATTEN = MATTEN (RINDEX,CINDEX)
            ATTEN = ATTEN * ( 1 +  AFLAG / 100 )
         END IF
   20    CONTINUE
******************************************************
*   INTERPOLATE ATTENUATION VALUES IF EXACT FREQUENCY IS
*   NOT IN THE FREQUENCY/ATTENUATION ARRAYS.
******************************************************
         IF ( .NOT. EXACT ) THEN
            DO 30 C=1,6
            IF ( FREQ .GT. MFREQ (RINDEX,C) .AND.
     $           FREQ .LT. MFREQ (RINDEX,C+1) )  THEN
               CINDEX = C
            END IF
   30       CONTINUE
            F = ALOG10 ( FREQ )
            LOFREQ = ALOG10 ( MFREQ (RINDEX, CINDEX) )
            HIFREQ = ALOG10 ( MFREQ (RINDEX, CINDEX + 1) )
            LOATTEN = MATTEN (RINDEX,CINDEX)
            HIATTEN = MATTEN (RINDEX, CINDEX + 1)
            FRAC = (F - LOFREQ) / (HIFREQ - LOFREQ)
            ATTEN = LOATTEN + (FRAC * (HIATTEN - LOATTEN) )
            ATTEN = ATTEN * ( 1 +  AFLAG / 100 )
         END IF
         RETURN
         END
```

```
--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  AFLAG       3   DUMMY-ARG                  REAL
  ATTEN     242B                             REAL
  C         254B                             INTEGER
  CINDEX    256B                             INTEGER
  EXACT     260B                             LOGICAL
  F         252B                             REAL
  FOUND     257B                             LOGICAL
  FRAC      243B                             REAL
  FREQ        2   DUMMY-ARG                  REAL
  HIATTEN   251B                             REAL
  HIFREQ    247B                             REAL
  ID          1   DUMMY-ARG                  CHAR*3
  IERR      262B                             INTEGER
  LOATTEN   250B                             REAL
  LOFREQ    246B                             REAL
  MAT        0B   /MATC/                     CHAR*3       100
  MATDESC   36B   /MATC/                     CHAR*70      100
  MATTEN     0B   /MATN/                     REAL         700
  MAXFREQ   245B                             REAL
  MERR     4374B  /MATN/                     INTEGER
  MFREQ    3100B  /MATN/                     REAL         700
  MINFREQ   244B                             REAL
  MRCOEF   1274B  /MATN/                     REAL         700
  MTOT     4375B  /MATN/                     INTEGER
  QA       2570B  /MATN/                     REAL         100
  QR       2734B  /MATN/                     REAL         100
  R         253B                             INTEGER
  RINDEX    255B                             INTEGER
```

```
  FUNCTION ATTEN     74/175  OPT=0

--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE------------------------VALUE

  MMAX     INTEGER                       100


--PROCEDURES--(LO=A)
 -NAME------TYPE--------ARGS------CLASS-----

  ALOG10    REAL            1      INTRINSIC
  ERROR                     1      SUBROUTINE


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

     10  INACTIVE   DO-TERM         44
     20  INACTIVE   DO-TERM         70
     30  INACTIVE   DO-TERM         81


--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  ATTEN       6B     3


--STATISTICS--

  PROGRAM-UNIT LENGTH            267B =  183
  CM LABELLED COMMON LENGTH     5730B =  3032
  CM STORAGE USED              61000B =  25088
  COMPILE TIME                 0.132 SECONDS
```

SUBROUTINE ERROR 74/175 OPT=0

```
      SUBROUTINE ERROR(IERR)                                            ERROR      1
      CHARACTER*45 MESSAGE(20)                                          ERROR      2
      DATA MESSAGE( 1)/'MATERIALS DATA BASE IS EMPTY               '/ ERROR      3
      DATA MESSAGE( 2)/'FREQUENCY IS OUT OF RANGE                  '/ ERROR      4
      DATA MESSAGE( 3)/'THIS MATERIAL IS NOT IN DATA BASE          '/ ERROR      5
      DATA MESSAGE( 4)/'DENOMINATOR IS ZERO                        '/ ERROR      6
      DATA MESSAGE( 5)/'FILE HANDLING ERROR                        '/ ERROR      7
      DATA MESSAGE( 6)/'ERROR CODE IS OUT OF RANGE                 '/ ERROR      8
      DATA MESSAGE( 7)/'ERROR CODE IS OUT OF RANGE                 '/ ERROR      9
      DATA MESSAGE( 8)/'ERROR CODE IS OUT OF RANGE                 '/ ERROR     10
      DATA MESSAGE( 9)/'ERROR CODE IS OUT OF RANGE                 '/ ERROR     11
      DATA MESSAGE(10)/'ERROR CODE IS OUT OF RANGE                 '/ ERROR     12
      DATA MESSAGE(11)/'ERROR CODE IS OUT OF RANGE                 '/ ERROR     13
      DATA MESSAGE(12)/'ERROR CODE IS OUT OF RANGE                 '/ ERROR     14
      DATA MESSAGE(13)/'ERROR CODE IS OUT OF RANGE                 '/ ERROR     15
      DATA MESSAGE(14)/'ERROR CODE IS OUT OF RANGE                 '/ ERROR     16
      DATA MESSAGE(15)/'ERROR CODE IS OUT OF RANGE                 '/ ERROR     17
      DATA MESSAGE(16)/'ERROR CODE IS OUT OF RANGE                 '/ ERROR     18
      DATA MESSAGE(17)/'ERROR CODE IS OUT OF RANGE                 '/ ERROR     19
      DATA MESSAGE(18)/'ERROR CODE IS OUT OF RANGE                 '/ ERROR     20
      DATA MESSAGE(19)/'ERROR CODE IS OUT OF RANGE                 '/ ERROR     21
      DATA MESSAGE(20)/'ERROR CODE IS OUT OF RANGE                 '/ ERROR     22
      IERRM=5                                                           ERROR     23
      IF(IERR.GT.IERRM) IERR=20                                         ERROR     24
      WRITE(6,10) IERR,MESSAGE(IERR)                                    ERROR     25
   10 FORMAT(' ***ERROR NUMBER = ',I5,' ***  ',A45)                     ERROR     26
      CALL PMDSTOP                                                      ERROR     27
      STOP 'ERROR'                                                      ERROR     28
      END                                                               ERROR     29
```

```
--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  IERR        1   DUMMY-ARG                  INTEGER
  IERRM     210B                             INTEGER
  MESSAGE    56B                             CHAR*45         20


--PROCEDURES--(LO=A)
 -NAME------TYPE--------ARGS------CLASS-----

  PMDSTOP                 0      SUBROUTINE


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

     10     36B     FORMAT          26


--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  ERROR       5B      1
```

```
--I/O UNITS--(LO=A)
 -NAME--- PROPERTIES-------------

  TAPE6   FMT/SEQ


--STATISTICS--

  PROGRAM-UNIT LENGTH           213B =  139
  CM STORAGE USED             61000B =  25088
  COMPILE TIME                0.055 SECONDS
```

```
      SUBROUTINE CFACTOR                                                CFACTOR     1
*[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[CFACTOR     2
*[[[                                                                [[[CFACTOR     3
*[[[ THIS ROUTINE CALCULATES THE ATTENUATION OF EACH WALL AND EACH  [[[CFACTOR     4
*[[[ OPENING IN EACH WALL, LAYER BY LAYER, AND THEN CALCULATES THE  [[[CFACTOR     5
*[[[ COMPOSITE TRANSMISSION FACTORS OF EACH WALL USING AN APPROACH  [[[CFACTOR     6
*[[[ DEVELOPED BY JERRY WYSS.                                       [[[CFACTOR     7
*[[[                                                                [[[CFACTOR     8
*[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[CFACTOR     9
************************************************************************CFACTOR    10
*** VARIABLE DEFINITIONS:                                               CFACTOR    11
***   WATTEN: WALL ATTENUATION                                          CFACTOR    12
***   OATTEN: OPENING ATTENUATION                                       CFACTOR    13
***   LATTEN: LAYER ATTENUATION                                         CFACTOR    14
***   MATTEN: MATERIAL ATTENUATION                                      CFACTOR    15
***   MAT: MATERIAL IDENTIFICATION                                      CFACTOR    16
***   ID: IDENTIFICATION OF OPENING                                     CFACTOR    17
***   WALL: WALL ARRAY CONTAINING WALL IDENTIFICATION AND MATERIAL      CFACTOR    18
***   WDIM: WALL ARRAY CONTAINING PHYSICAL DIMENSIONS OF THE WALL       CFACTOR    19
***   WMAX: MAXIMUM SIZE OF WALL AND WDIM ARRAYS                        CFACTOR    20
***   WTOT: TOTAL LINES OF DATA IN THE THE WALL AND WDIM ARRAYS.        CFACTOR    21
***   HEIGHT: HEIGHT OF WALL                                            CFACTOR    22
***   WIDTH: WIDTH OF WALL                                              CFACTOR    23
***   WDIM(R,C): THICKNESS OF WALL                                      CFACTOR    24
***   AREA: AREA                                                        CFACTOR    25
***   WAREA: TOTAL WALL AREA WITHOUT SUBTRACTING OPENINGS.              CFACTOR    26
***   OAREA: TOTAL AREA OF THE OPENINGS.                                CFACTOR    27
***   NEWWALL: TRUE IF DATA LINE BELONGS TO A NEW WALL                  CFACTOR    28
***   WALLEND: TRUE IF DATA LINE IS THE LAST DATA LINE OF A WALL        CFACTOR    29
***   T: TRANSMISSION FACTOR                                            CFACTOR    30
***   S: AREA OF OPENING OR WALL AS APPROPRIATE                         CFACTOR    31
***   TS: TRANSMISSION FACTOR = T1*S1 + T2S2 + T3*S3 + ...              CFACTOR    32
***   TS2: TRANSMISSION FACTOR = T1*S1*S1 + T2*S2*S2 + ...              CFACTOR    33
************************************************************************CFACTOR    34
************************************************************************COMF        1
*** COMMON FOR INITIAL PARAMETERS                                    ***COMF        2
************************************************************************COMF        3
      INTEGER FMAX                                                      COMF        4
      PARAMETER (FMAX = 50)                                             COMF        5
      COMMON /INITILN/ FREQ, QUALITY, AFLAG, RFLAG, FREQA(FMAX), FERR,  COMF        6
     $                 FTOT                                             COMF        7
      COMMON /INITILC/ BLDG                                             COMF        8
      CHARACTER * 5 BLDG                                                COMF        9
      REAL FREQ, AFLAG, RFLAG, FREQA                                    COMF       10
      INTEGER QUALITY, FERR, FTOT                                       COMF       11
************************************************************************COMF       12
************************************************************************COMF       13
************************************************************************COMH        1
***   COMMON FOR DATABASE OF LOCATIONS OF DOORS AND WINDOWS          ***COMH        2
************************************************************************COMH        3
      INTEGER HMAX                                                      COMH        4
      PARAMETER (HMAX = 35)                                             COMH        5
      COMMON /HOLEN/ HTOT, HERR                                         COMH        6
      COMMON /HOLEC/ HOLE(HMAX,4)                                       COMH        7
      INTEGER HTOT, HERR                                                COMH        8
      CHARACTER * 3 HOLE                                                COMH        9
* ==================================================                    COMH       10
* DESCRIPTION OF ARRAYS                                                 COMH       11
* ==================================================                    COMH       12
*     ROOM IDENTIFICATION              APERTURE ID                      COMH       13
* -----------------------------------                                   COMH       14
* DIRECTION    FROM ROOM    TO ROOM                                     COMH       15
* --------------------------------------------------                    COMH       16
* HOLE(X,1)    HOLE(X,2)    HOLE(X,3)    HOLE(X,4)                      COMH       17
```

```
*   A3              A3              A3              A3                      COMH      18
************************************************************************COMH      19
************************************************************************COMH      20
************************************************************************COMT       1
***   COMMON FOR DATABASE OF TYPES OF DOORS AND WINDOWS                 ***COMT       2
************************************************************************COMT       3
      INTEGER TMAX                                                      COMT       4
      PARAMETER (TMAX=35)                                               COMT       5
      COMMON /TYPEN/TDIM(TMAX,4),TTOT,TDB2(TMAX,2),TDBTOT,TERR          COMT       6
      COMMON /TYPEC/TYPE(TMAX,3),TDB1(TMAX)                             COMT       7
      INTEGER TTOT,TDBTOT,TERR                                          COMT       8
      REAL TDIM,TDB2                                                    COMT       9
      CHARACTER * 3 TYPE,TDB1                                           COMT      10
*==================================================                     COMT      11
* DESCRIPTION OF ARRAYS                                                 COMT      12
*==================================================                     COMT      13
*   ID        MATERIAL    FRAME MATERIAL                                COMT      14
*--------------------------------------------------                     COMT      15
*TYPE(X,1)   TYPE(X,2)   TYPE(X,3)                                      COMT      16
* A3          A3          A3                                            COMT      17
*==================================================                     COMT      18
* HEIGHT      WIDTH       LAYER       DISTANCE                          COMT      19
*                         THICKNESS   ABOVE FLOOR                       COMT      20
*--------------------------------------------------                     COMT      21
* TDIM(X,1)   TDIM(X,2)   TDIM(X,3)   TDIM(X,4)                         COMT      22
*  F8.2        F8.2        F8.2        F8.2                             COMT      23
*==================================================                     COMT      24
*  ID       ATTENUATION    AREA                                         COMT      25
* -------------------------------------------------                     COMT      26
* TDB1(X)    TDB2(X,1)    TDB2(X,2)                                     COMT      27
*   A3          E9.3         E9.3                                       COMT      28
************************************************************************COMT      29
************************************************************************COMT      30
************************************************************************COMR       1
***   COMMON FOR ROOM ARRAY CONTAINING ATTENUATION OF WALLS             ***COMR       2
************************************************************************COMR       3
      INTEGER RMAX                                                      COMR       4
      PARAMETER (RMAX = 20)                                             COMR       5
      COMMON /ROOMN/ ROOM(RMAX + 6, RMAX + 6), NROOMS, RAREA(RMAX)      COMR       6
      INTEGER NROOMS                                                    COMR       7
      REAL ROOM                                                         COMR       8
************************************************************************COMR       9
************************************************************************COMR      10
************************************************************************COMW       1
***   COMMON FOR DATABASE OF WALL PARAMETERS                            ***COMW       2
************************************************************************COMW       3
      INTEGER WMAX                                                      COMW       4
      PARAMETER (WMAX = 75)                                             COMW       5
      COMMON /WALLN/ WDIM(WMAX,3), WTOT, WERR                           COMW       6
      COMMON /WALLC/ WALL(WMAX,4)                                       COMW       7
      INTEGER WTOT,WERR                                                 COMW       8
      REAL WDIM                                                         COMW       9
      CHARACTER *3 WALL                                                 COMW      10
* =================================                                     COMW      11
** DESCRIPTION OF ARRAYS                                                COMW      12
* =================================                                     COMW      13
*    WALL IDENTIFICATION                                                COMW      14
* ---------------------------------                                     COMW      15
* DIRECTION    FROM        TO                                           COMW      16
*              ROOM        ROOM                                         COMW      17
* ---------------------------------                                     COMW      18
* WALL(X,1)   WALL(X,2)   WALL(X,3)                                     COMW      19
*  A3          A3          A3                                           COMW      20
* =======================================================               COMW      21
```

```
      *        WALL PARAMETERS                                          COMW      22
      * -----------------------------------------------------------     COMW      23
      * MATERIAL    HEIGHT      WIDTH       LAYER THICKNESS             COMW      24
      * -----------------------------------------------------------     COMW      25
      * WALL(X,4)   WDIM(X,1)   WDIM(X,2)   WDIM(X,3)                   COMW      26
      *  A3         F8.2        F8.2        F8.2                        COMW      27
      ***********************************************************************COMW      28
      ***********************************************************************COMW      29
      ***********************************************************************COMD       1
      *     COMMON FOR ABSORPTION AND REFLECTION COEFFICIENTS IN WALLS  COMD       2
      ***********************************************************************COMD       3
            COMMON /ROOMD/DDABS(RMAX + 6, RMAX + 6 ) ,DREFL, DREFLW     COMD       4
            REAL DDABS ,DREFL , DREFLW                                  COMD       5
      ***********************************************************************COMD       6
      ***********************************************************************COMD       7
      ****************************************************              CFACTOR   41
      *   DECLARATION OF VARIABLES                                      CFACTOR   42
      ****************************************************              CFACTOR   43
            INTEGER NEXT, LAST, R, C, ROW                               CFACTOR   44
            REAL WATTEN,LATTEN,OATTEN,MATTEN,ATTEN,T,S,TS,TS2           CFACTOR   45
            REAL HEIGHT,WIDTH,AREA,OAREA,WAREA                          CFACTOR   46
            CHARACTER * 3 FROM, TO, MAT, ID                             CFACTOR   47
            LOGICAL NEWWALL,WALLEND                                     CFACTOR   48
      ****************************************************              CFACTOR   49
      *   INITIALIZE ROOM MATRIX.                                       CFACTOR   50
      ****************************************************              CFACTOR   51
            DO 5 R = 1,RMAX                                             CFACTOR   52
              DO 5 C = 1,RMAX                                           CFACTOR   53
                ROOM(R,C) = 0.0                                         CFACTOR   54
         5  CONTINUE                                                    CFACTOR   55
            DO 6 R = 1,RMAX                                             CFACTOR   56
              DO 6 C = RMAX + 1, RMAX + 5                               CFACTOR   57
                ROOM(R,C) = 0.0                                         CFACTOR   58
         6  CONTINUE                                                    CFACTOR   59
      ****************************************************              CFACTOR   60
      *   LOOP & PROCESS EACH LAYER OF THE WALL ARRAY                   CFACTOR   61
      ****************************************************              CFACTOR   62
            DO 10 R = 1,WTOT                                            CFACTOR   63
      ****************************************************              CFACTOR   64
      *   SET WALLEND CONDITION                                         CFACTOR   65
      ****************************************************              CFACTOR   66
              NEXT = R + 1                                              CFACTOR   67
              IF (R .EQ. WTOT) THEN                                     CFACTOR   68
                WALLEND = .TRUE.                                        CFACTOR   69
              ELSE IF ( WALL(R,2) .NE. WALL(NEXT,2) .OR.                CFACTOR   70
           $           WALL(R,3) .NE. WALL(NEXT,3) ) THEN               CFACTOR   71
                WALLEND = .TRUE.                                        CFACTOR   72
              ELSE                                                      CFACTOR   73
                WALLEND = .FALSE.                                       CFACTOR   74
              END IF                                                    CFACTOR   75
      ****************************************************              CFACTOR   76
      *   SET NEWWALL CONDITION                                         CFACTOR   77
      ****************************************************              CFACTOR   78
              LAST = R - 1                                              CFACTOR   79
              IF (R .EQ. 1) THEN                                        CFACTOR   80
                NEWWALL = .TRUE.                                        CFACTOR   81
              ELSE IF ( WALL(R,2) .NE. WALL(LAST,2) .OR.                CFACTOR   82
           $           WALL(R,3) .NE. WALL(LAST,3) ) THEN               CFACTOR   83
                NEWWALL = .TRUE.                                        CFACTOR   84
              ELSE                                                      CFACTOR   85
                NEWWALL = .FALSE.                                       CFACTOR   86
              END IF                                                    CFACTOR   87
      ****************************************************              CFACTOR   88
      ****************************************************              CFACTOR   89
```

```
*   CALCULATE WALL ATTENUATION, LAYER BY LAYER
**************************************************
         IF (NEWWALL) THEN
**************************************************
*      ...INITIALIZE WALL CONDITIONS
**************************************************
           TS = 0
           TS2 = 0
           WATTEN = 0
         END IF
**************************************************
*      ...CALCULATE ATTENUATION OF LAYER
**************************************************
         MAT = WALL(R,4)
         MATTEN = ATTEN (MAT,FREQ,AFLAG)
         LATTEN = MATTEN * WDIM(R,3)
**************************************************
*      ACCUMULATE ATTENUATION OF WALL FROM LAYERS
**************************************************
         WATTEN = WATTEN + LATTEN
**************************************************
**************************************************
*      CHECK IF END-OF-WALL LAYER
*      AND THEN CALCULATE VALUES FOR HOLES IF TRUE.
*      OTHERWISE GO BACK AND DO THE NEXT LAYER.
**************************************************
         IF (WALLEND) THEN
           FROM = WALL(R,2)
           TO   = WALL(R,3)
**************************************************
*   ...CALCULATE ATTENUATION OF OPENINGS
*   ...AND TOTAL AREA OF OPENINGS
**************************************************
           OAREA = 0
           DO 20 ROW = 1, HTOT
**************************************************
*   ...CHECK FOR A HOLE IN PRESENT WALL
**************************************************
             IF (HOLE(ROW,2) .EQ. FROM .AND. HOLE(ROW,3) .EQ. TO) THEN
**************************************************
*   ...IF THERE IS A MATCH, CALCULATE ITS CONTRIBUTION;
*   ...OTHERWISE KEEP SEARCHING HOLE'S TABLE
**************************************************
               ID = HOLE(ROW,4)
**************************************************
*   ...GET ATTENUATION AND AREA OF HOLE
**************************************************
               CALL SRCHTDB(ID, OATTEN,AREA)
               OAREA = OAREA + AREA
       CALL RESOND (ID)
               IF (OATTEN .LE. 120) THEN
**************************************************
*   ...CALCULATE TRANSMISSION OF HOLE.
*   ...SET TO ZERO IF LESS THAN 120 DB
**************************************************
                 T = 10**((-OATTEN + DREFLW) / 10 )
               ELSE
                 T = 0
               END IF
               S = AREA
**************************************************
*   ...ACCUMULATE TRANSMISSION * AREA AND
*   ...TRANSMISSION * AREA * AREA
*   ...FOR HOLES IN WALL.
```

```
*****************************************************
                TS = TS + T * S
                TS2 = TS2 + T * S * S
              END IF
 20         CONTINUE
******************************************************
*****************************************************
*****************************************************
*   CALCULATE & STORE ATTENUATION OF EACH ROOM
*****************************************************
*   ...CALCULATE TOTAL WALL AREA
*****************************************************
            HEIGHT = WDIM(R,1)
            WIDTH = WDIM(R,2)
            WAREA = HEIGHT * WIDTH
            S = WAREA - OAREA
*****************************************************
*   ...CALCULATE ATTENUATION
*****************************************************
            IF (WATTEN .LE. 120.) THEN
*****************************************************
*       ...CALCULATE TRANSMISSION OF WALL.
*       ...SET TO ZERO IF LESS THAN -120 DB.
*****************************************************
              T = 10**(-WATTEN / 10)
            ELSE
              T = 0
            END IF
            TS = TS + T * S
            TS2 = TS2 + T * S * S
*****************************************************
*       ...INSERT TOTAL TRANSMISSION * AREA OF WALL INTO ROOM ARRAY
*****************************************************
            CALL LROOM (TS,TS2,FROM,TO)
          END IF
 10     CONTINUE
        RETURN
        END
```

--VARIABLE MAP--(LO=A)

-NAME---	ADDRESS--	BLOCK-----	PROPERTIES-------	TYPE---------	SIZE
AFLAG	2B	/INITILN/		REAL	
AREA	500B			REAL	
BLDG	0B	/INITILC/		CHAR*5	
C	464B			INTEGER	
DDABS	0B	/ROOMD/		REAL	676
DREFL	1244B	/ROOMD/		REAL	
DREFLW	1245B	/ROOMD/		REAL	
FERR	66B	/INITILN/		INTEGER	
FREQ	0B	/INITILN/		REAL	
FREQA	4B	/INITILN/		REAL	50
FROM	503B			CHAR*3	
FTOT	67B	/INITILN/		INTEGER	
HEIGHT	476B			REAL	
HERR	1B	/HOLEN/		INTEGER	
HOLE	0B	/HOLEC/		CHAR*3	140
HTOT	0B	/HOLEN/		INTEGER	
ID	506B			CHAR*3	
LAST	462B			INTEGER	
LATTEN	467B			REAL	
MAT	505B			CHAR*3	
MATTEN	471B			REAL	

```
 NEWWALL    507B                                   LOGICAL
 NEXT       461B                                   INTEGER
 NROOMS    1244B  /ROOMN/                          INTEGER
 OAREA      501B                                   REAL
 OATTEN     470B                                   REAL
 QUALITY      1B  /INITILN/                        INTEGER
 R          463B                                   INTEGER
 RAREA     1245B  /ROOMN/                          REAL            20
 RFLAG        3B  /INITILN/                        REAL
 ROOM         0B  /ROOMN/                          REAL           676
 ROW        465B                                   INTEGER
 S          473B                                   REAL
 T          472B                                   REAL
 TDBTOT     323B  /TYPEN/                          INTEGER
 TDB1        37B  /TYPEC/                          CHAR*3          35
 TDB2       215B  /TYPEN/                          REAL            70
 TDIM         0B  /TYPEN/                          REAL           140
 TERR       324B  /TYPEN/                          INTEGER
 TO         504B                                   CHAR*3
 TS         474B                                   REAL
 TS2        475B                                   REAL
 TTOT       214B  /TYPEN/                          INTEGER
 TYPE         0B  /TYPEC/                          CHAR*3         105
 WALL         0B  /WALLC/                          CHAR*3         300
 WALLEND    510B                                   LOGICAL
 WAREA      502B                                   REAL
 WATTEN     466B                                   REAL
 WDIM         0B  /WALLN/                          REAL           225
 WERR       342B  /WALLN/                          INTEGER
 WIDTH      477B                                   REAL
 WTOT       341B  /WALLN/                          INTEGER


--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE------------------------VALUE

 FMAX     INTEGER                         50
 HMAX     INTEGER                         35
 RMAX     INTEGER                         20
 TMAX     INTEGER                         35
 WMAX     INTEGER                         75


--PROCEDURES--(LO=A)
 -NAME------TYPE--------ARGS------CLASS-----

 ATTEN      REAL            3      FUNCTION
 LROOM                      4      SUBROUTINE
 RESOND                     1      SUBROUTINE
 SRCHTDB                    3      SUBROUTINE


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

     5  INACTIVE   DO-TERM       158
     6  INACTIVE   DO-TERM       162
    10  INACTIVE   DO-TERM       292
    20  INACTIVE   DO-TERM       261
```

```
SUBROUTINE CFACTOR  74/175  OPT=0

--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  CFACTOR     5B     0


--STATISTICS--

  PROGRAM-UNIT LENGTH             521B =  337
  CM LABELLED COMMON LENGTH      4000B =  2048
  CM STORAGE USED               63000B =  26112
  COMPILE TIME                  0.249 SECONDS
```

```
      SUBROUTINE LHOLE                                                  LHOLE      1
*[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[LHOLE      2
*[[[                                                                [[[LHOLE      3
*[[[   LOAD THE CONTENTS OF THE "HOLE" FILE INTO THE "HOLE" ARRAY    [[[LHOLE      4
*[[[                                                                [[[LHOLE      5
*[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[LHOLE      6
***********************************************************************COMH       1
***    COMMON FOR DATABASE OF LOCATIONS OF DOORS AND WINDOWS        ***COMH       2
***********************************************************************COMH       3
      INTEGER HMAX                                                     COMH       4
      PARAMETER (HMAX = 35)                                            COMH       5
      COMMON /HOLEN/ HTOT, HERR                                        COMH       6
      COMMON /HOLEC/ HOLE(HMAX,4)                                      COMH       7
      INTEGER HTOT, HERR                                               COMH       8
      CHARACTER * 3 HOLE                                               COMH       9
* =================================================                    COMH      10
* DESCRIPTION OF ARRAYS                                                COMH      11
* =================================================                    COMH      12
*     ROOM IDENTIFICATION              APERTURE ID                     COMH      13
* ---------------------------------                                    COMH      14
* DIRECTION    FROM ROOM     TO ROOM                                   COMH      15
* -------------------------------------------------                    COMH      16
* HOLE(X,1)    HOLE(X,2)     HOLE(X,3)    HOLE(X,4)                    COMH      17
*   A3            A3            A3           A3                        COMH      18
***********************************************************************COMH      19
***********************************************************************COMH      20
***********************************************************************COMF       1
*** COMMON FOR INITIAL PARAMETERS                                   ***COMF       2
***********************************************************************COMF       3
      INTEGER FMAX                                                     COMF       4
      PARAMETER (FMAX = 50)                                            COMF       5
      COMMON /INITILN/ FREQ, QUALITY, AFLAG, RFLAG, FREQA(FMAX), FERR,  COMF       6
     $                 FTOT                                            COMF       7
      COMMON /INITILC/ BLDG                                            COMF       8
      CHARACTER * 5 BLDG                                               COMF       9
      REAL FREQ, AFLAG, RFLAG, FREQA                                   COMF      10
      INTEGER QUALITY, FERR, FTOT                                      COMF      11
***********************************************************************COMF      12
***********************************************************************COMF      13
      INTEGER GETLEN, R, C                                             LHOLE      9
      CHARACTER * 7  PFN                                               LHOLE     10
      PFN = 'B' // BLDG(1:GETLEN(BLDG)) // 'H'                         LHOLE     11
      HERR = 0                                                         LHOLE     12
      CALL PF  ('GET',0,PFN(1:GETLEN(PFN)),'RC',HERR)                  LHOLE     13
      IF ( HERR .EQ. 0 ) THEN                                          LHOLE     14
        OPEN (UNIT=3, FILE=PFN, FORM='FORMATTED',                      LHOLE     15
     $        STATUS='OLD', ACCESS='SEQUENTIAL')                       LHOLE     16
1000    FORMAT (1X,4(1X,A3))                                           LHOLE     17
        HTOT = 0                                                       LHOLE     18
        DO 10 R = 1,HMAX                                               LHOLE     19
          READ (3,1000,END=20)(HOLE(R,C),C=1,4)                        LHOLE     20
          HTOT = HTOT + 1                                              LHOLE     21
10      CONTINUE                                                       LHOLE     22
20      CONTINUE                                                       LHOLE     23
        CLOSE(3,STATUS='DELETE')                                       LHOLE     24
      ELSE IF ( HERR .EQ. 2 ) THEN                                     LHOLE     25
        CALL WARNING (1)                                               LHOLE     26
      ELSE                                                             LHOLE     27
        CALL WARNING (2)                                               LHOLE     28
      END IF                                                           LHOLE     29
      RETURN                                                           LHOLE     30
      END                                                              LHOLE     31
```

```
--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  AFLAG       2B  /INITILN/                    REAL
  BLDG        0B  /INITILC/                    CHAR*5
  C         214B                               INTEGER
  FERR       66B  /INITILN/                    INTEGER
  FREQ        0B  /INITILN/                    REAL
  FREQA       4B  /INITILN/                    REAL              50
  FTOT       67B  /INITILN/                    INTEGER
  HERR        1B  /HOLEN/                      INTEGER
  HOLE        0B  /HOLEC/                      CHAR*3           140
  HTOT        0B  /HOLEN/                      INTEGER
  PFN       215B                               CHAR*7
  QUALITY     1B  /INITILN/                    INTEGER
  R         213B                               INTEGER
  RFLAG       3B  /INITILN/                    REAL


--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE------------------------VALUE

  FMAX    INTEGER                         50
  HMAX    INTEGER                         35


--PROCEDURES--(LO=A)
 -NAME------TYPE--------ARGS------CLASS-----

  GETLEN    INTEGER         1       FUNCTION
  PF                        5       SUBROUTINE
  WARNING                   1       SUBROUTINE


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

     10  INACTIVE   DO-TERM        53
     20     73B                    54
   1000    130B     FORMAT         48


--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  LHOLE       5B     0


--I/O UNITS--(LO=A)
 -NAME--- PROPERTIES-------------

  TAPE3   AUX/FMT/SEQ


--STATISTICS--

  PROGRAM-UNIT LENGTH            222B =  146
  CM LABELLED COMMON LENGTH      145B =  101
  CM STORAGE USED              61000B =  25088
  COMPILE TIME                 0.094 SECONDS
```

```
      SUBROUTINE LMATTER                                                LMATTER        1
*[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[LMATTER        2
*[[[                                                                 [[[LMATTER        3
*[[[   THIS SUBROUTINE LOADS THE MATERIAL DATABASE INTO ARRAYS FOR   [[[LMATTER        4
*[[[   FURTHER PROGRAM USE.                                          [[[LMATTER        5
*[[[                                                                 [[[LMATTER        6
*[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[LMATTER        7
************************************************************************LMATTER        8
************************************************************************COMM           1
***   COMMON FOR DATABASE OF MATERIAL PROPERTIES                     ***COMM           2
************************************************************************COMM           3
      INTEGER MMAX                                                      COMM           4
      PARAMETER (MMAX=100)                                              COMM           5
      COMMON /MATN/ MATTEN(MMAX,7), MRCOEF(MMAX,7), QA(MMAX), QR(MMAX), COMM           6
     $              MFREQ(MMAX,7), MERR, MTOT                           COMM           7
      COMMON /MATC/MAT(MMAX),MATDESC(MMAX)                              COMM           8
      INTEGER MTOT, MERR                                                COMM           9
      REAL MATTEN, MRCOEF, MFREQ, QA, QR                                COMM          10
      CHARACTER * 3  MAT                                                COMM          11
      CHARACTER * 70 MATDESC                                            COMM          12
************************************************************************COMM          13
************************************************************************COMM          14
**************************************************                      LMATTER       10
*   DECLARATION OF VARIABLES                                            LMATTER       11
**************************************************                      LMATTER       12
      INTEGER R, C, VAL                                                 LMATTER       13
      CHARACTER * 3 MATID                                               LMATTER       14
**************************************************                      LMATTER       15
*  GET FILE                                                             LMATTER       16
**************************************************                      LMATTER       17
      MERR = 0                                                          LMATTER       18
      CALL PF ('GET',0,'MATTER','RC',MERR)                              LMATTER       19
**************************************************                      LMATTER       20
*  FILE ERROR CHECK                                                     LMATTER       21
**************************************************                      LMATTER       22
      IF ( MERR .EQ. 0 ) THEN                                           LMATTER       23
999     CONTINUE                                                        LMATTER       24
      ELSE IF ( MERR .EQ. 2 ) THEN                                      LMATTER       25
        CALL WARNING (3)                                                LMATTER       26
        RETURN                                                          LMATTER       27
      ELSE                                                              LMATTER       28
        CALL WARNING (4)                                                LMATTER       29
        RETURN                                                          LMATTER       30
      END IF                                                            LMATTER       31
**************************************************                      LMATTER       32
*   OPEN FILE                                                           LMATTER       33
**************************************************                      LMATTER       34
      OPEN (UNIT = 3, FILE='MATTER',FORM='FORMATTED',                   LMATTER       35
     $      STATUS = 'OLD', ACCESS = 'SEQUENTIAL')                      LMATTER       36
      REWIND (3)                                                        LMATTER       37
**************************************************                      LMATTER       38
*  INITIALIZE ARRAYS                                                    LMATTER       39
**************************************************                      LMATTER       40
      DATA MAT / 100 * '   ' /                                          LMATTER       41
      DATA MATDESC / 100 * '   ' /                                      LMATTER       42
      DATA MFREQ / 700 * 0.0 /                                          LMATTER       43
      DATA MATTEN / 700 * 0.0 /                                         LMATTER       44
      DATA QA / 100 * 0.0 /                                             LMATTER       45
      DATA MRCOEF / 700 * 0.0 /                                         LMATTER       46
      DATA QR / 100 * 0.0 /                                             LMATTER       47
**************************************************                      LMATTER       48
*  READ IN THE MATERIAL FILE                                            LMATTER       49
**************************************************                      LMATTER       50
10    READ (3,1000,END=20) MATID                                        LMATTER       51
```

```
     65        R = VAL(MATID(2:3))                                          LMATTER      52
     66        MAT (R) = MATID                                              LMATTER      53
     67        READ (3,2000,END=20) MATDESC (R)                             LMATTER      54
     68        READ (3,4000,END=20) (MFREQ(R,C),C=1,7)                      LMATTER      55
     69        READ (3,4000,END=20) (MATTEN(R,C),C=1,7)                     LMATTER      56
     70        READ (3,4000,END=20) QA (R)                                  LMATTER      57
     71        READ (3,4000,END=20) (MRCOEF(R,C),C=1,7)                     LMATTER      58
     72        READ (3,4000,END=20) QR (R)                                  LMATTER      59
     73        GOTO 10                                                      LMATTER      60
     74 20     CONTINUE                                                     LMATTER      61
     75 1000   FORMAT (A3)                                                  LMATTER      62
     76 2000   FORMAT (A70)                                                 LMATTER      63
     77 4000   FORMAT (7(1X,E9.3))                                          LMATTER      64
     78 ************************************************************        LMATTER      65
     79 *  CLOSE FILE                                                       LMATTER      66
     80 ************************************************************        LMATTER      67
     81        CLOSE (3,STATUS = 'DELETE')                                  LMATTER      68
     82        RETURN                                                       LMATTER      69
     83        END                                                          LMATTER      70
```

```
--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  C          327B                            INTEGER
  MAT          0B  /MATC/                    CHAR*3          100
  MATDESC     36B  /MATC/                    CHAR*70         100
  MATID      330B                            CHAR*3
  MATTEN       0B  /MATN/                    REAL            700
  MERR      4374B  /MATN/                    INTEGER
  MFREQ     3100B  /MATN/                    REAL            700
  MRCOEF    1274B  /MATN/                    REAL            700
  MTOT      4375B  /MATN/                    INTEGER
  QA        2570B  /MATN/                    REAL            100
  QR        2734B  /MATN/                    REAL            100
  R          326B                            INTEGER
```

```
--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE------------------------VALUE

  MMAX    INTEGER                       100
```

```
--PROCEDURES--(LO=A)
 -NAME------TYPE--------ARGS------CLASS-----

  PF                      5      SUBROUTINE
  VAL       INTEGER       1      FUNCTION
  WARNING                 1      SUBROUTINE
```

```
--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF       -LABEL-ADDRESS-----PROPERTIES----DEF

    10     36B                     64         1000     202B     FORMAT         75
    20    160B                     74         2000     204B     FORMAT         76
   999 *NO REFS*                   37         4000     206B     FORMAT         77
```

```
SUBROUTINE LMATTER  74/175  OPT=0

--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  LMATTER     5B     0


--I/O UNITS--(LO=A)
 -NAME--- PROPERTIES-------------

  TAPE3   AUX/FMT/SEQ


--STATISTICS--

  PROGRAM-UNIT LENGTH            336B =  222
  CM LABELLED COMMON LENGTH     5730B =  3032
  CM STORAGE USED              61000B =  25088
  COMPILE TIME                 0.138 SECONDS
```

```
      SUBROUTINE LRAREA                                                 LRAREA     1
*[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[LRAREA     2
*[[[                                                                 [[[LRAREA     3
*[[[  CALCULATE THE SURFACE AREA OF EACH ROOM                        [[[LRAREA     4
*[[[ AND INSERT IT IN THE "RAREA" ARRAY                              [[[LRAREA     5
*[[[                                                                 [[[LRAREA     6
*[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[LRAREA     7
************************************************************************COMR       1
***   COMMON FOR ROOM ARRAY CONTAINING ATTENUATION OF WALLS          ***COMR       2
************************************************************************COMR       3
      INTEGER RMAX                                                      COMR       4
      PARAMETER (RMAX = 20)                                             COMR       5
      COMMON /ROOMN/ ROOM(RMAX + 6, RMAX + 6), NROOMS, RAREA(RMAX)      COMR       6
      INTEGER NROOMS                                                    COMR       7
      REAL ROOM                                                         COMR       8
************************************************************************COMR       9
************************************************************************COMR      10
************************************************************************COMW       1
***   COMMON FOR DATABASE OF WALL PARAMETERS                         ***COMW       2
************************************************************************COMW       3
      INTEGER WMAX                                                      COMW       4
      PARAMETER (WMAX = 75)                                             COMW       5
      COMMON /WALLN/ WDIM(WMAX,3), WTOT, WERR                           COMW       6
      COMMON /WALLC/ WALL(WMAX,4)                                       COMW       7
      INTEGER WTOT,WERR                                                 COMW       8
      REAL WDIM                                                         COMW       9
      CHARACTER *3 WALL                                                 COMW      10
* =================================                                     COMW      11
** DESCRIPTION OF ARRAYS                                                COMW      12
* =================================                                     COMW      13
*    WALL IDENTIFICATION                                                COMW      14
* ---------------------------------                                     COMW      15
* DIRECTION    FROM       TO                                            COMW      16
*              ROOM       ROOM                                          COMW      17
* ---------------------------------                                     COMW      18
* WALL(X,1)   WALL(X,2)   WALL(X,3)                                     COMW      19
*  A3          A3          A3                                           COMW      20
* ==========================================================            COMW      21
*        WALL PARAMETERS                                                COMW      22
* ----------------------------------------------------------            COMW      23
* MATERIAL    HEIGHT      WIDTH       LAYER THICKNESS                   COMW      24
* ----------------------------------------------------------            COMW      25
* WALL(X,4)   WDIM(X,1)   WDIM(X,2)   WDIM(X,3)                         COMW      26
*  A3         F8.2        F8.2        F8.2                              COMW      27
************************************************************************COMW      28
************************************************************************COMW      29
**************************************************                      LRAREA    10
*   DECLARATION OF VARIABLES                                            LRAREA    11
**************************************************                      LRAREA    12
      INTEGER NEXT, LAST, R, RNUM, VAL                                  LRAREA    13
      CHARACTER * 3 FROM, TO                                            LRAREA    14
      LOGICAL NEWWALL, WALLEND                                          LRAREA    15
**************************************************                      LRAREA    16
*                                                                       LRAREA    17
**************************************************                      LRAREA    18
**************************************************                      LRAREA    19
*   INITIALIZE RAREA MATRIX TO ZERO                                     LRAREA    20
**************************************************                      LRAREA    21
      DO 5 I = 1,RMAX                                                   LRAREA    22
    5 RAREA(I) = 0.0                                                    LRAREA    23
**************************************************                      LRAREA    24
*                                                                       LRAREA    25
**************************************************                      LRAREA    26
      DO 10  R = 1,WTOT                                                 LRAREA    27
```

```
*****************************************************
*   SET WALLEND CONDITION
*****************************************************
      NEXT = R + 1
      IF (R .EQ. WTOT) THEN
        WALLEND = .TRUE.
      ELSE IF ( WALL(R,2) .NE. WALL(NEXT,2) .OR.
     $          WALL(R,3) .NE. WALL(NEXT,3) ) THEN
        WALLEND = .TRUE.
      ELSE
        WALLEND = .FALSE.
      END IF
*****************************************************
*   SET NEWWALL CONDITION
*****************************************************
      LAST = R - 1
      IF (R .EQ. 1) THEN
        NEWWALL = .TRUE.
      ELSE IF ( WALL(R,2) .NE. WALL(LAST,2) .OR.
     $          WALL(R,3) .NE. WALL(LAST,3) ) THEN
        NEWWALL = .TRUE.
      ELSE
        NEWWALL = .FALSE.
      END IF
*****************************************************
*   INSERT THE AREA INTO THE ARRAY
*****************************************************
      IF (NEWWALL) THEN
        FROM = WALL (R,2)
        TO = WALL (R,3)
        IF ( FROM(1:1) .EQ. 'D') THEN
          RNUM = VAL ( TO(1:2) )
          RAREA(RNUM) = RAREA (RNUM) + WDIM(R,1)*WDIM(R,2)
        ELSE IF ( TO(1:1) .EQ. 'D' ) THEN
          RNUM = VAL ( FROM(1:2) )
          RAREA(RNUM) = RAREA (RNUM) + WDIM(R,1)*WDIM(R,2)
        ELSE IF (( FROM(1:1) .NE. 'D' ) .AND. ( TO(1:1) .NE. 'D' )) THEN
          RNUM = VAL (FROM(1:2) )
          RAREA(RNUM) = RAREA (RNUM) + WDIM(R,1)*WDIM(R,2)
          RNUM = VAL ( TO(1:2) )
          RAREA(RNUM) = RAREA (RNUM) + WDIM(R,1)*WDIM(R,2)
        END IF
      END IF
*
 10   CONTINUE
      RETURN
      END
```

--VARIABLE MAP--(LO=A)

-NAME---	ADDRESS--	BLOCK-----	PROPERTIES-------	TYPE---------	SIZE
FROM	275B			CHAR*3	
I	301B			INTEGER	
LAST	272B			INTEGER	
NEWWALL	277B			LOGICAL	
NEXT	271B			INTEGER	
NROOMS	1244B	/ROOMN/		INTEGER	
R	273B			INTEGER	
RAREA	1245B	/ROOMN/		REAL	20
RNUM	274B			INTEGER	
ROOM	0B	/ROOMN/		REAL	676
TO	276B			CHAR*3	
WALL	0B	/WALLC/		CHAR*3	300

```
 WALLEND   300B                             LOGICAL
 WDIM        0B  /WALLN/                    REAL          225
 WERR      342B  /WALLN/                    INTEGER
 WTOT      341B  /WALLN/                    INTEGER


--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE------------------------VALUE

 RMAX    INTEGER                        20
 WMAX    INTEGER                        75


--PROCEDURES--(LO=A)
 -NAME------TYPE--------ARGS------CLASS-----

 VAL        INTEGER        1      FUNCTION


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

     5  INACTIVE   DO-TERM        60
    10  INACTIVE   DO-TERM       109


--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

 LRAREA      5B     0


--STATISTICS--

 PROGRAM-UNIT LENGTH            306B =  198
 CM LABELLED COMMON LENGTH     1766B =  1014
 CM STORAGE USED              61000B =  25088
 COMPILE TIME                 0.133 SECONDS
```

```
      SUBROUTINE LROOM (TS,TS2,FROM,TO )                                LROOM       1
*[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[LROOM       2
*[[[                                                                 [[[LROOM       3
*** THIS ROUTINE LOADS THE TRANSMISSION COEFFICIENT INTO THE APPROPRIATELROOM       4
*** LOCATION IN THE 'ROOM' ARRAY.                                       LROOM       5
***                                                                     LROOM       6
*** NROOMS: TOTAL NUMBERS OF ROOMS REPRESENTED BY DATA                  LROOM       7
*** RMAX: MAXIMUM NUMBER POSSIBLE UNDER THE PRESENT PROGRAM CONFIGURATIOLROOM       8
*** TS AND TS2: TRANSMISSION COEFFICIENTS                               LROOM       9
*** FROM: TO: CONTAINS ROOM#'S OR THE DIRECTIONS D1,D2,4,D5,OR D6.      LROOM      10
*[[[                                                                 [[[LROOM      11
*[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[LROOM      12
************************************************************************LROOM      13
************************************************************************COMR        1
***    COMMON FOR ROOM ARRAY CONTAINING ATTENUATION OF WALLS         ***COMR        2
************************************************************************COMR        3
      INTEGER RMAX                                                      COMR        4
      PARAMETER (RMAX = 20)                                             COMR        5
      COMMON /ROOMN/ ROOM(RMAX + 6, RMAX + 6), NROOMS, RAREA(RMAX)      COMR        6
      INTEGER NROOMS                                                    COMR        7
      REAL ROOM                                                         COMR        8
************************************************************************COMR        9
************************************************************************COMR       10
*************************************************                       LROOM      15
*   DECLARATION OF VARIABLES                                            LROOM      16
*************************************************                       LROOM      17
      INTEGER VAL, C, R, RNUM, D                                        LROOM      18
      REAL TS, TS2                                                      LROOM      19
      CHARACTER * 3 FROM, TO                                            LROOM      20
*************************************************                       LROOM      21
*                                                                       LROOM      22
*************************************************                       LROOM      23
      IF ( FROM(1:1) .EQ. 'D' ) THEN                                    LROOM      24
         RNUM = VAL ( TO(1:2) )                                         LROOM      25
         D = VAL ( FROM(2:2) )                                          LROOM      26
*************************************************                       LROOM      27
*  INSERT TRANSMISSION COEFFICENT FOR ENERGY ENTERING A ROOM FROM THE   LROOM      28
*  OUTSIDE OF THE BUILDING.                                             LROOM      29
*************************************************                       LROOM      30
         R = NROOMS + D                                                 LROOM      31
         C = RNUM                                                       LROOM      32
         ROOM(R,C) = TS  + ROOM(R,C)                                    LROOM      33
*************************************************                       LROOM      34
*  INSERT TRANSMISSION COEFFICIENT INTO 'ROOM' ARRAY FOR ENERGY LEAVING LROOM      35
*  A ROOM TO THE OUTSIDE OF THE BUILDING.                               LROOM      36
*************************************************                       LROOM      37
         R = RNUM                                                       LROOM      38
         C = NROOMS + D                                                 LROOM      39
         ROOM(R,C) = TS2 / RAREA(RNUM) + ROOM(R,C)                      LROOM      40
*************************************************                       LROOM      41
*                                                                       LROOM      42
*************************************************                       LROOM      43
      ELSE IF ( TO(1:1) .EQ. 'D' ) THEN                                 LROOM      44
         RNUM = VAL ( FROM(1:2) )                                       LROOM      45
         D = VAL ( TO(2:2) )                                            LROOM      46
*************************************************                       LROOM      47
*  INSERT TRANSMISSION COEFFICIENT INTO 'ROOM' ARRAY FOR ENERGY ENTERINGLROOM      48
*  A ROOM FROM THE OUTSIDE OF THE BUILDING.                             LROOM      49
*************************************************                       LROOM      50
         R = NROOMS + D                                                 LROOM      51
         C = RNUM                                                       LROOM      52
         ROOM(R,C) = TS  + ROOM(R,C)                                    LROOM      53
*************************************************                       LROOM      54
*  INSERT TRANSMISSION COEFFICIENT INTO 'ROOM' ARRAY FOR ENERGY LEAVING LROOM      55
```

```
* A ROOM TO THE OUTSIDE OF THE BUILDING.                                  LROOM    56
*************************************************                         LROOM    57
         R = RNUM                                                         LROOM    58
         C = NROOMS + D                                                   LROOM    59
         ROOM(R,C) = TS2 / RAREA(RNUM) + ROOM(R,C)                        LROOM    60
*************************************************                         LROOM    61
*                                                                         LROOM    62
*************************************************                         LROOM    63
      ELSE                                                                LROOM    64
*************************************************                         LROOM    65
*  INSERT TRANSMISSION COEFFICIENTS INTO 'ROOM' ARRAY FOR ENERGY GOIN     LROOM    66
*  FROM ROOM TO ROOM.                                                     LROOM    67
*************************************************                         LROOM    68
         R = VAL ( FROM(1:2) )                                            LROOM    69
         C = VAL ( TO(1:2) )                                              LROOM    70
         ROOM(R,C) = TS2 / RAREA(R)  + ROOM(R,C)                          LROOM    71
         ROOM(C,R) = TS2 / RAREA(C)  + ROOM(C,R)                          LROOM    72
      END IF                                                              LROOM    73
      RETURN                                                              LROOM    74
      END                                                                 LROOM    75
```

--VARIABLE MAP--(LO=A)

-NAME-	--ADDRESS--	--BLOCK-----PROPERTIES-------	-TYPE---------	-SIZE
C	222B		INTEGER	
D	225B		INTEGER	
FROM	3	DUMMY-ARG	CHAR*3	
NROOMS	1244B	/ROOMN/	INTEGER	
R	223B		INTEGER	
RAREA	1245B	/ROOMN/	REAL	20
RNUM	224B		INTEGER	
ROOM	0B	/ROOMN/	REAL	676
TO	4	DUMMY-ARG	CHAR*3	
TS	1	DUMMY-ARG	REAL	
TS2	2	DUMMY-ARG	REAL	

--SYMBOLIC CONSTANTS--(LO=A)

-NAME-	---TYPE------------------------	VALUE
RMAX	INTEGER	20

--PROCEDURES--(LO=A)

-NAME------	TYPE--------	ARGS------	CLASS-----
VAL	INTEGER	1	FUNCTION

--ENTRY POINTS--(LO=A)

-NAME---	ADDRESS--	ARGS---
LROOM	5B	4

```
--STATISTICS--

 PROGRAM-UNIT LENGTH              230B =  152
 CM LABELLED COMMON LENGTH       1271B =  697
 CM STORAGE USED                61000B =  25088
 COMPILE TIME                   0.100 SECONDS
```

```
      INTEGER FUNCTION VAL(STRING)                                      LROOM
*[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[LROOM
*[[[                                                                [[[LROOM
*[[[   RETURNS THE INTEGER VALUE OF A STRING.                       [[[LROOM
*[[[                                                                [[[LROOM
*[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[LROOM
************************************************************************LROOM
      INTEGER NUMBER,  X, L, EXP, DIGIT, GETLEN                         LROOM
      CHARACTER * (*) STRING                                            LROOM
*                                                                       LROOM
      L = GETLEN(STRING)                                                LROOM
      NUMBER = 0                                                        LROOM
      DO 10 X = L,1,-1                                                  LROOM
        EXP = L - X                                                     LROOM
        DIGIT = ICHAR(STRING(X:X)) - 16                                 LROOM
        NUMBER = NUMBER + DIGIT*10**EXP                                 LROOM
10    CONTINUE                                                          LROOM
      VAL = NUMBER                                                      LROOM
      RETURN                                                            LROOM
      END                                                               LROOM
```

```
--VARIABLE MAP--(LO=A)
-NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

 DIGIT      76B                             INTEGER
 EXP        75B                             INTEGER
 L          74B                             INTEGER
 NUMBER     72B                             INTEGER
 STRING      1   DUMMY-ARG                  CHAR*(*)
 VAL        71B                             INTEGER
 X          73B                             INTEGER


--PROCEDURES--(LO=A)
-NAME------TYPE--------ARGS------CLASS-----

 GETLEN    INTEGER        1      FUNCTION
 ICHAR     INTEGER        1      INTRINSIC


--STATEMENT LABELS--(LO=A)
-LABEL-ADDRESS-----PROPERTIES----DEF

    10  INACTIVE   DO-TERM        17


--ENTRY POINTS--(LO=A)
-NAME---ADDRESS--ARGS---

 VAL         6B     1


--STATISTICS--

 PROGRAM-UNIT LENGTH           102B =  66
 CM STORAGE USED             61000B =  25088
 COMPILE TIME                0.039 SECONDS
```

```
      INTEGER FUNCTION GETLEN (STRING)                                  LROOM        96
*[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[LROOM        97
*[[[                                                                 [[[LROOM        98
*[[[   DETERMINE LENGTH OF STRING EXCLUDING ANY BLANK PADDING         [[[LROOM        99
*[[[                                                                 [[[LROOM       100
*[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[LROOM       101
***********************************************************************LROOM       102
*                                                                       LROOM       103
* ARGUMENT DEFINITIONS --                                               LROOM       104
*    INPUT ARGUMENTS                                                    LROOM       105
*      STRING - STRING WHOSE LENGTH IS TO BE DETERMINED                 LROOM       106
*                                                                       LROOM       107
**************************************************                      LROOM       108
      CHARACTER * (*) STRING                                            LROOM       109
**************************************************                      LROOM       110
*  FUNCTION PARAMETERS                                                  LROOM       111
**************************************************                      LROOM       112
      CHARACTER * 1 BLANK                                               LROOM       113
      PARAMETER (BLANK = ' ')                                           LROOM       114
**************************************************                      LROOM       115
*  LOCAL VARIABLES                                                      LROOM       116
**************************************************                      LROOM       117
      INTEGER NEXT                                                      LROOM       118
**************************************************                      LROOM       119
*  START WITH THE LAST CHARACTER AND FIND THE FIRST NON-BLANK           LROOM       120
**************************************************                      LROOM       121
      DO 10 NEXT = LEN(STRING),1,-1                                     LROOM       122
         IF (STRING(NEXT : NEXT) .NE. BLANK) THEN                       LROOM       123
            GETLEN = NEXT                                               LROOM       124
            RETURN                                                      LROOM       125
         END IF                                                         LROOM       126
   10 CONTINUE                                                          LROOM       127
**************************************************                      LROOM       128
*  ALL CHARACTERS ARE BLANKS                                            LROOM       129
**************************************************                      LROOM       130
      GETLEN = 0                                                        LROOM       131
*                                                                       LROOM       132
      RETURN                                                            LROOM       133
      END                                                               LROOM       134
```

```
--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  GETLEN     63B                             INTEGER
  NEXT       64B                             INTEGER
  STRING      1   DUMMY-ARG                  CHAR*(*)


--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE-----------------------VALUE

  BLANK   CHAR*1                      ' '


--PROCEDURES--(LO=A)
 -NAME------TYPE--------ARGS------CLASS-----

  LEN       INTEGER        1      INTRINSIC
```

```
--STATEMENT LABELS--(LO=A)
-LABEL-ADDRESS-----PROPERTIES----DEF

    10  INACTIVE   DO-TERM         32


--ENTRY POINTS--(LO=A)
-NAME---ADDRESS--ARGS---

  GETLEN      6B     1


--STATISTICS--

  PROGRAM-UNIT LENGTH            70B =  56
  CM STORAGE USED             61000B =  25088
  COMPILE TIME                0.039 SECONDS
```

```
      SUBROUTINE LTDB                                                   LTDB
*[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[LTDB
*[[[                                                                 [[[LTDB
*[[[   THIS ROUTINE CALCULATES THE ATTENUATION OF EACH DOOR AND      [[[LTDB
*[[[   WINDOW                                                        [[[LTDB
*[[[                                                                 [[[LTDB
*[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[LTDB
************************************************************************LTDB
* VARIABLE DEFINITIONS                                                  LTDB
*   ID: IDENTIFICATION OF OPENING                                       LTDB
*   OATTEN: OPENING ATTENUATION                                         LTDB
*   LATTEN: LAYER ATTENUATION                                           LTDB
*   MATTEN:  MATERIAL ATTENUATION                                       LTDB
*   MAT: MATERIAL IDENTIFICATION                                        LTDB
*   TDBTOT:  TOTAL LINES OF DATA IN THE TDB1 AND TDB2 ARRAYS            LTDB
*   HEIGHT: HEIGHT OF DOOR OR WINDOW OPENING                            LTDB
*   WIDTH:  WIDTH OF DOOR OR WINDOW                                     LTDB
*   T: THICKNESS OF LAYER                                               LTDB
*   AREA: AREA                                                          LTDB
*   NEWTYPE: TRUE IF DATA LINE BELONGS TO A NEW DOOR OR WINDOW TYPE     LTDB
*   TYPEEND: TRUE IF DATA LINE IS THE LAST DATA LINE OF AN OPENING TYPE LTDB
************************************************************************LTDB
************************************************************************COMF
*** COMMON FOR INITIAL PARAMETERS                                    ***COMF
************************************************************************COMF
      INTEGER FMAX                                                      COMF
      PARAMETER (FMAX = 50)                                             COMF
      COMMON /INITILN/ FREQ, QUALITY, AFLAG, RFLAG, FREQA(FMAX), FERR,  COMF
     $                 FTOT                                             COMF
      COMMON /INITILC/ BLDG                                             COMF
      CHARACTER * 5 BLDG                                                COMF
      REAL FREQ, AFLAG, RFLAG, FREQA                                    COMF
      INTEGER QUALITY, FERR, FTOT                                       COMF
************************************************************************COMF
************************************************************************COMF
************************************************************************COMT
***   COMMON FOR DATABASE OF TYPES OF DOORS AND WINDOWS              ***COMT
************************************************************************COMT
      INTEGER TMAX                                                      COMT
      PARAMETER (TMAX=35)                                               COMT
      COMMON /TYPEN/TDIM(TMAX,4),TTOT,TDB2(TMAX,2),TDBTOT,TERR          COMT
      COMMON /TYPEC/TYPE(TMAX,3),TDB1(TMAX)                             COMT
      INTEGER TTOT,TDBTOT,TERR                                          COMT
      REAL TDIM,TDB2                                                    COMT
      CHARACTER * 3 TYPE,TDB1                                           COMT
*================================================                       COMT
* DESCRIPTION OF ARRAYS                                                 COMT
*================================================                       COMT
*   ID        MATERIAL    FRAME MATERIAL                                COMT
*------------------------------------------------                       COMT
*TYPE(X,1)   TYPE(X,2)   TYPE(X,3)                                      COMT
* A3          A3          A3                                            COMT
*================================================                       COMT
* HEIGHT      WIDTH       LAYER       DISTANCE                          COMT
*                         THICKNESS   ABOVE FLOOR                       COMT
*------------------------------------------------                       COMT
* TDIM(X,1)   TDIM(X,2)   TDIM(X,3)   TDIM(X,4)                         COMT
*  F8.2        F8.2        F8.2        F8.2                             COMT
*================================================                       COMT
*  ID       ATTENUATION    AREA                                         COMT
* -----------------------------------------------                       COMT
* TDB1(X)    TDB2(X,1)    TDB2(X,2)                                     COMT
*   A3          E9.3         E9.3                                       COMT
************************************************************************COMT
```

```
************************************************************************COMT       30
**************************************************                      LTDB       25
*   DECLARATION OF VARIABLES                                            LTDB       26
**************************************************                      LTDB       27
      INTEGER NEXT, LAST, R                                             LTDB       28
      REAL LATTEN, OATTEN, MATTEN, ATTEN                                LTDB       29
      REAL HEIGHT, WIDTH, AREA                                          LTDB       30
      CHARACTER * 3 MAT , ID                                            LTDB       31
      LOGICAL NEWTYPE, TYPEEND                                          LTDB       32
**************************************************                      LTDB       33
*                                                                       LTDB       34
**************************************************                      LTDB       35
      TDBTOT = 0                                                        LTDB       36
      DO 10 R = 1, TTOT                                                 LTDB       37
**************************************************                      LTDB       38
*   SET TYPEEND CONDITION                                               LTDB       39
**************************************************                      LTDB       40
      NEXT = R + 1                                                      LTDB       41
      IF (R .EQ. TTOT) THEN                                             LTDB       42
        TYPEEND = .TRUE.                                                LTDB       43
      ELSE IF ( TYPE(R,1) .NE. TYPE(NEXT,1) ) THEN                      LTDB       44
        TYPEEND = .TRUE.                                                LTDB       45
      ELSE                                                              LTDB       46
        TYPEEND = .FALSE.                                               LTDB       47
      END IF                                                            LTDB       48
**************************************************                      LTDB       49
*   SET NEWTYPE CONDITION                                               LTDB       50
**************************************************                      LTDB       51
      LAST = R - 1                                                      LTDB       52
      IF (R .EQ. 1) THEN                                                LTDB       53
        NEWTYPE = .TRUE.                                                LTDB       54
      ELSE IF ( TYPE(R,1) .NE. TYPE(LAST,1) ) THEN                      LTDB       55
        NEWTYPE = .TRUE.                                                LTDB       56
      ELSE                                                              LTDB       57
        NEWTYPE = .FALSE.                                               LTDB       58
      END IF                                                            LTDB       59
**************************************************                      LTDB       60
*   CALCULATE                                                           LTDB       61
**************************************************                      LTDB       62
      IF (NEWTYPE) THEN                                                 LTDB       63
**************************************************                      LTDB       64
*         ..INITIALIZE TYPE CONDITIONS                                  LTDB       65
**************************************************                      LTDB       66
        OATTEN = 0                                                      LTDB       67
      END IF                                                            LTDB       68
**************************************************                      LTDB       69
*     ...CALCULATE ATTENUATION FACTOR OF LAYER                          LTDB       70
**************************************************                      LTDB       71
      MAT = TYPE(R,2)                                                   LTDB       72
      MATTEN = ATTEN (MAT,FREQ,AFLAG)                                   LTDB       73
      T = TDIM(R,3)                                                     LTDB       74
      LATTEN = MATTEN * T                                               LTDB       75
**************************************************                      LTDB       76
*     ..CALCULATE RUNNING ATTENUATION FACTOR OF OPENING                 LTDB       77
**************************************************                      LTDB       78
      OATTEN = OATTEN + LATTEN                                          LTDB       79
      IF (TYPEEND) THEN                                                 LTDB       80
**************************************************                      LTDB       81
*      ....CALCULATE TOTAL OPENING AREA                                 LTDB       82
**************************************************                      LTDB       83
         HEIGHT = TDIM(R,1)                                             LTDB       84
         WIDTH = TDIM(R,2)                                              LTDB       85
         AREA = HEIGHT * WIDTH                                          LTDB       86
**************************************************                      LTDB       87
```

```
      *  INSERT ID, ATTENUATION AND AREA INTO TYPE DATABASE ARRAYS          LTDB        88
      ***************************************************                   LTDB        89
               TDBTOT = TDBTOT + 1                                          LTDB        90
               ID = TYPE(R,1)                                               LTDB        91
               TDB1(TDBTOT) = ID                                            LTDB        92
               TDB2(TDBTOT,1) = OATTEN                                      LTDB        93
               TDB2(TDBTOT,2) = AREA                                        LTDB        94
            END IF                                                          LTDB        95
         10 CONTINUE                                                        LTDB        96
            RETURN                                                          LTDB        97
            END                                                             LTDB        98
```

```
--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  AFLAG       2B  /INITILN/                  REAL
  AREA      221B                             REAL
  BLDG        0B  /INITILC/                  CHAR*5
  FERR       66B  /INITILN/                  INTEGER
  FREQ        0B  /INITILN/                  REAL
  FREQA       4B  /INITILN/                  REAL             50
  FTOT       67B  /INITILN/                  INTEGER
  HEIGHT    217B                             REAL
  ID        223B                             CHAR*3
  LAST      212B                             INTEGER
  LATTEN    214B                             REAL
  MAT       222B                             CHAR*3
  MATTEN    216B                             REAL
  NEWTYPE   224B                             LOGICAL
  NEXT      211B                             INTEGER
  OATTEN    215B                             REAL
  QUALITY     1B  /INITILN/                  INTEGER
  R         213B                             INTEGER
  RFLAG       3B  /INITILN/                  REAL
  T         227B                             REAL
  TDBTOT    323B  /TYPEN/                    INTEGER
  TDB1       37B  /TYPEC/                    CHAR*3           35
  TDB2      215B  /TYPEN/                    REAL             70
  TDIM        0B  /TYPEN/                    REAL            140
  TERR      324B  /TYPEN/                    INTEGER
  TTOT      214B  /TYPEN/                    INTEGER
  TYPE        0B  /TYPEC/                    CHAR*3          105
  TYPEEND   225B                             LOGICAL
  WIDTH     220B                             REAL


--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE------------------------VALUE

  FMAX    INTEGER                       50
  TMAX    INTEGER                       35


--PROCEDURES--(LO=A)
 -NAME------TYPE--------ARGS------CLASS-----

  ATTEN     REAL          3       FUNCTION
```

```
--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

     10  INACTIVE   DO-TERM       137


--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  LTDB        5B     0


--STATISTICS--

  PROGRAM-UNIT LENGTH            232B =  154
  CM LABELLED COMMON LENGTH      470B =  312
  CM STORAGE USED              61000B =  25088
  COMPILE TIME                 0.116 SECONDS
```

```
      SUBROUTINE LTYPE                                                  LTYPE      1
*[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[LTYPE      2
*[[[                                                                [[[LTYPE      3
*[[[  LOAD THE "TYPE" ARRAYS FROM THE TYPE DATA FILE                [[[LTYPE      4
*[[[                                                                [[[LTYPE      5
*[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[LTYPE      6
************************************************************************LTYPE      7
***********************************************************************COMT      1
***   COMMON FOR DATABASE OF TYPES OF DOORS AND WINDOWS              ***COMT      2
***********************************************************************COMT      3
      INTEGER TMAX                                                     COMT      4
      PARAMETER (TMAX=35)                                              COMT      5
      COMMON /TYPEN/TDIM(TMAX,4),TTOT,TDB2(TMAX,2),TDBTOT,TERR         COMT      6
      COMMON /TYPEC/TYPE(TMAX,3),TDB1(TMAX)                            COMT      7
      INTEGER TTOT,TDBTOT,TERR                                         COMT      8
      REAL TDIM,TDB2                                                   COMT      9
      CHARACTER * 3 TYPE,TDB1                                          COMT     10
*==================================================                    COMT     11
* DESCRIPTION OF ARRAYS                                                COMT     12
*==================================================                    COMT     13
*   ID        MATERIAL    FRAME MATERIAL                               COMT     14
*--------------------------------------------------                    COMT     15
*TYPE(X,1)   TYPE(X,2)   TYPE(X,3)                                    COMT     16
* A3          A3          A3                                           COMT     17
*==================================================                    COMT     18
* HEIGHT      WIDTH       LAYER       DISTANCE                         COMT     19
*                         THICKNESS   ABOVE FLOOR                      COMT     20
*--------------------------------------------------                    COMT     21
* TDIM(X,1)   TDIM(X,2)   TDIM(X,3)   TDIM(X,4)                        COMT     22
*  F8.2        F8.2        F8.2        F8.2                            COMT     23
*==================================================                    COMT     24
*  ID       ATTENUATION    AREA                                        COMT     25
* -------------------------------------------------                    COMT     26
* TDB1(X)    TDB2(X,1)    TDB2(X,2)                                    COMT     27
*   A3          E9.3         E9.3                                      COMT     28
***********************************************************************COMT     29
***********************************************************************COMT     30
***********************************************************************COMF      1
*** COMMON FOR INITIAL PARAMETERS                                    ***COMF      2
***********************************************************************COMF      3
      INTEGER FMAX                                                     COMF      4
      PARAMETER (FMAX = 50)                                            COMF      5
      COMMON /INITILN/ FREQ, QUALITY, AFLAG, RFLAG, FREQA(FMAX), FERR, COMF      6
     $                 FTOT                                            COMF      7
      COMMON /INITILC/ BLDG                                            COMF      8
      CHARACTER * 5 BLDG                                               COMF      9
      REAL FREQ, AFLAG, RFLAG, FREQA                                   COMF     10
      INTEGER QUALITY, FERR, FTOT                                      COMF     11
***********************************************************************COMF     12
***********************************************************************COMF     13
**************************************************                     LTYPE     10
*   DECLARATION OF VARIABLES                                           LTYPE     11
**************************************************                     LTYPE     12
      INTEGER GETLEN, R, C                                             LTYPE     13
      CHARACTER * 7  PFN                                               LTYPE     14
**************************************************                     LTYPE     15
*                                                                      LTYPE     16
**************************************************                     LTYPE     17
      PFN = 'B' // BLDG(1:GETLEN(BLDG)) // 'T'                         LTYPE     18
      TERR = 0                                                         LTYPE     19
      CALL PF ('GET',0,PFN(1ETLEN(PFN)),'RC',TERR)                   LTYPE     20
      IF (TERR .EQ. 0 ) THEN                                           LTYPE     21
        OPEN (UNIT=3, FILE=PFN, FORM='FORMATTED',                      LTYPE     22
     $        STATUS='OLD', ACCESS='SEQUENTIAL')                       LTYPE     23
```

```
   1000    FORMAT (1X,3(1X,A3),4(1X,F8.2))
           TTOT = 0
           DO 10 R = 1,TMAX
             READ (3,1000,END=20)(TYPE(R,C),C=1,3),(TDIM(R,C),C=1,4)
             TTOT = TTOT + 1
   10      CONTINUE
   20      CONTINUE
           CLOSE(3,STATUS='DELETE')
         ELSE IF ( TERR .EQ. 2 ) THEN
           CALL WARNING (5)
         ELSE
           CALL WARNING (6)
         END IF
         RETURN
         END
```

```
--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  AFLAG        2B  /INITILN/                 REAL
  BLDG         0B  /INITILC/                 CHAR*5
  C          236B                            INTEGER
  FERR        66B  /INITILN/                 INTEGER
  FREQ         0B  /INITILN/                 REAL
  FREQA        4B  /INITILN/                 REAL               50
  FTOT        67B  /INITILN/                 INTEGER
  PFN        237B                            CHAR*7
  QUALITY      1B  /INITILN/                 INTEGER
  R          235B                            INTEGER
  RFLAG        3B  /INITILN/                 REAL
  TDBTOT     323B  /TYPEN/                   INTEGER
  TDB1        37B  /TYPEC/                   CHAR*3             35
  TDB2       215B  /TYPEN/                   REAL               70
  TDIM         0B  /TYPEN/                   REAL              140
  TERR       324B  /TYPEN/                   INTEGER
  TTOT       214B  /TYPEN/                   INTEGER
  TYPE         0B  /TYPEC/                   CHAR*3            105
```

```
--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE------------------------VALUE

  FMAX    INTEGER                       50
  TMAX    INTEGER                       35
```

```
--PROCEDURES--(LO=A)
 -NAME------TYPE--------ARGS------CLASS-----

  GETLEN    INTEGER        1       FUNCTION
  PF                       5       SUBROUTINE
  WARNING                  1       SUBROUTINE
```

```
--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

     10  INACTIVE   DO-TERM        70
     20    111B                    71
   1000    147B     FORMAT         65
```

```
SUBROUTINE LTYPE    74/175  OPT=0

--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  LTYPE        5B      0


--I/O UNITS--(LO=A)
 -NAME--- PROPERTIES-------------

  TAPE3   AUX/FMT/SEQ


--STATISTICS--

  PROGRAM-UNIT LENGTH              245B =  165
  CM LABELLED COMMON LENGTH        470B =  312
  CM STORAGE USED                63000B =  26112
  COMPILE TIME                   0.103 SECONDS
```

```
      SUBROUTINE LWALL                                                  LWALL     1
*[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[LWALL     2
*[[[                                                                 [[[LWALL     3
*[[[   LOAD THE CONTENTS OF THE FILE 'WALLS' INTO ARRAYS WALL AND WDIM. LWALL     4
*[[[                                                                 [[[LWALL     5
*[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[LWALL     6
************************************************************************LWALL     7
************************************************************************COMW      1
***   COMMON FOR DATABASE OF WALL PARAMETERS                         ***COMW      2
************************************************************************COMW      3
      INTEGER WMAX                                                      COMW      4
      PARAMETER (WMAX = 75)                                             COMW      5
      COMMON /WALLN/ WDIM(WMAX,3), WTOT, WERR                           COMW      6
      COMMON /WALLC/ WALL(WMAX,4)                                       COMW      7
      INTEGER WTOT,WERR                                                 COMW      8
      REAL WDIM                                                         COMW      9
      CHARACTER *3 WALL                                                 COMW     10
* =================================                                     COMW     11
** DESCRIPTION OF ARRAYS                                                COMW     12
* =================================                                     COMW     13
*    WALL IDENTIFICATION                                                COMW     14
* ---------------------------------                                     COMW     15
* DIRECTION    FROM       TO                                            COMW     16
*              ROOM       ROOM                                          COMW     17
* ---------------------------------                                     COMW     18
* WALL(X,1)   WALL(X,2)   WALL(X,3)                                     COMW     19
*  A3          A3          A3                                           COMW     20
* =========================================================             COMW     21
*        WALL PARAMETERS                                                COMW     22
* ---------------------------------------------------------             COMW     23
* MATERIAL    HEIGHT      WIDTH       LAYER THICKNESS                   COMW     24
* ---------------------------------------------------------             COMW     25
* WALL(X,4)   WDIM(X,1)   WDIM(X,2)   WDIM(X,3)                         COMW     26
*  A3         F8.2        F8.2        F8.2                              COMW     27
************************************************************************COMW     28
************************************************************************COMW     29
************************************************************************COMF      1
*** COMMON FOR INITIAL PARAMETERS                                    ***COMF      2
************************************************************************COMF      3
      INTEGER FMAX                                                      COMF      4
      PARAMETER (FMAX = 50)                                             COMF      5
      COMMON /INITILN/ FREQ, QUALITY, AFLAG, RFLAG, FREQA(FMAX), FERR,  COMF      6
     $                 FTOT                                             COMF      7
      COMMON /INITILC/ BLDG                                             COMF      8
      CHARACTER * 5 BLDG                                                COMF      9
      REAL FREQ, AFLAG, RFLAG, FREQA                                    COMF     10
      INTEGER QUALITY, FERR, FTOT                                       COMF     11
************************************************************************COMF     12
************************************************************************COMF     13
**************************************************                      LWALL    10
*   DECLARATION OF VARIABLES                                            LWALL    11
**************************************************                      LWALL    12
      INTEGER GETLEN, R, C                                              LWALL    13
      CHARACTER * 7 NAME, PFN                                           LWALL    14
**************************************************                      LWALL    15
*                                                                       LWALL    16
**************************************************                      LWALL    17
      NAME = 'B'//BLDG(1:GETLEN(BLDG))//'W'                             LWALL    18
      PFN = NAME (1:GETLEN(NAME))                                       LWALL    19
      WERR = 0                                                          LWALL    20
      CALL PF ('GET',0,PFN(1ETLEN(PFN)),'RC',WERR)                    LWALL    21
      IF ( WERR .EQ. 0 ) THEN                                           LWALL    22
        OPEN (UNIT=3, FILE=PFN, FORM='FORMATTED',                       LWALL    23
     $        STATUS='OLD', ACCESS='SEQUENTIAL')                        LWALL    24
```

```
65 1000     FORMAT (1X,4(1X,A3),3(1X,F8.2))
66            WTOT = 0
67            DO 10 R = 1,WMAX
68              READ (3,1000,END=20)(WALL(R,C),C=1,4),(WDIM(R,C),C=1,3)
69              WTOT = WTOT + 1
70 10         CONTINUE
71 20         CONTINUE
72            CLOSE(3,STATUS='DELETE')
73          ELSE IF ( WERR .EQ. 2 ) THEN
74            CALL WARNING (7)
75          ELSE
76            CALL WARNING (8)
77          END IF
78          RETURN
79          END
```

```
--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  AFLAG       2B   /INITILN/                   REAL
  BLDG        0B   /INITILC/                   CHAR*5
  C         255B                               INTEGER
  FERR       66B   /INITILN/                   INTEGER
  FREQ        0B   /INITILN/                   REAL
  FREQA       4B   /INITILN/                   REAL              50
  FTOT       67B   /INITILN/                   INTEGER
  NAME      256B                               CHAR*7
  PFN       257B                               CHAR*7
  QUALITY     1B   /INITILN/                   INTEGER
  R         254B                               INTEGER
  RFLAG       3B   /INITILN/                   REAL
  WALL        0B   /WALLC/                     CHAR*3           300
  WDIM        0B   /WALLN/                     REAL             225
  WERR      342B   /WALLN/                     INTEGER
  WTOT      341B   /WALLN/                     INTEGER


--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE------------------------VALUE

  FMAX    INTEGER                        50
  WMAX    INTEGER                        75


--PROCEDURES--(LO=A)
 -NAME------TYPE--------ARGS------CLASS-----

  GETLEN    INTEGER         1       FUNCTION
  PF                        5       SUBROUTINE
  WARNING                   1       SUBROUTINE


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

     10  INACTIVE   DO-TERM         70
     20    117B                     71
   1000    155B     FORMAT          65
```

```
SUBROUTINE LWALL    74/175  OPT=0

--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  LWALL       5B     0


--I/O UNITS--(LO=A)
 -NAME--- PROPERTIES-------------

  TAPE3   AUX/FMT/SEQ


--STATISTICS--

  PROGRAM-UNIT LENGTH            265B =  181
  CM LABELLED COMMON LENGTH      566B =  374
  CM STORAGE USED              63000B =  26112
  COMPILE TIME                 0.108 SECONDS
```

```
      SUBROUTINE PHOLE                                                  PHOLE      1
*[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[PHOLE      2
*[[[                                                                 [[[PHOLE      3
*[[[   PRINT OUT THE CONTENTS OF THE HOLE ARRAY                      [[[PHOLE      4
*[[[                                                                 [[[PHOLE      5
*[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[PHOLE      6
************************************************************************PHOLE      7
************************************************************************COMH       1
***   COMMON FOR DATABASE OF LOCATIONS OF DOORS AND WINDOWS          ***COMH       2
************************************************************************COMH       3
      INTEGER HMAX                                                      COMH       4
      PARAMETER (HMAX = 35)                                             COMH       5
      COMMON /HOLEN/ HTOT, HERR                                         COMH       6
      COMMON /HOLEC/ HOLE(HMAX,4)                                       COMH       7
      INTEGER HTOT, HERR                                                COMH       8
      CHARACTER * 3 HOLE                                                COMH       9
* ====================================================                  COMH      10
* DESCRIPTION OF ARRAYS                                                 COMH      11
* ====================================================                  COMH      12
*     ROOM IDENTIFICATION              APERTURE ID                      COMH      13
* -----------------------------------                                   COMH      14
* DIRECTION    FROM ROOM     TO ROOM                                    COMH      15
* ----------------------------------------------------                  COMH      16
* HOLE(X,1)    HOLE(X,2)     HOLE(X,3)    HOLE(X,4)                     COMH      17
*   A3            A3            A3            A3                        COMH      18
************************************************************************COMH      19
************************************************************************COMH      20
      INTEGER R,C                                                       PHOLE      9
      PRINT *                                                           PHOLE     10
      PRINT *,' DOOR AND WINDOW LOCATIONS'                              PHOLE     11
      PRINT*,'***************************'                              PHOLE     12
      PRINT*,'       WALL IDENTIFICATION'                               PHOLE     13
      PRINT*,'     ----------------------'                              PHOLE     14
      PRINT*,' ID    DIRECTION  FROM  TO'                               PHOLE     15
      PRINT*,'==== ======================'                              PHOLE     16
      DO 10 R = 1,HTOT                                                  PHOLE     17
        PRINT 1000,HOLE(R,4),(HOLE(R,C),C=1,3)                          PHOLE     18
   10 CONTINUE                                                          PHOLE     19
      PRINT*,'==========================='                              PHOLE     20
 1000 FORMAT (2X,A3,5X,3(3X,A3))                                        PHOLE     21
      RETURN                                                            PHOLE     22
      END                                                               PHOLE     23
```

```
--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  C         174B                             INTEGER
  HERR        1B   /HOLEN/                   INTEGER
  HOLE        0B   /HOLEC/                   CHAR*3         140
  HTOT        0B   /HOLEN/                   INTEGER
  R         173B                             INTEGER


--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE------------------------VALUE

  HMAX    INTEGER                        35
```

```
--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

     10  INACTIVE   DO-TERM        38
   1000    124B     FORMAT         40


--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  PHOLE       5B     0


--STATISTICS--

  PROGRAM-UNIT LENGTH             201B =  129
  CM LABELLED COMMON LENGTH        54B =  44
  CM STORAGE USED               61000B =  25088
  COMPILE TIME                  0.062 SECONDS
```

```
      SUBROUTINE PROOM                                                  PROOM        1
*[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[PROOM        2
*[[[                                                                 [[[PROOM        3
*[[[   PRINTOUT THE CONTENTS OF THE ROOM MATRIX                      [[[PROOM        4
*[[[                                                                 [[[PROOM        5
*[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[PROOM        6
************************************************************************PROOM        7
************************************************************************COMF         1
*** COMMON FOR INITIAL PARAMETERS                                    ***COMF         2
************************************************************************COMF         3
      INTEGER FMAX                                                      COMF         4
      PARAMETER (FMAX = 50)                                             COMF         5
      COMMON /INITILN/ FREQ, QUALITY, AFLAG, RFLAG, FREQA(FMAX), FERR,  COMF         6
     $                 FTOT                                             COMF         7
      COMMON /INITILC/ BLDG                                             COMF         8
      CHARACTER * 5 BLDG                                                COMF         9
      REAL FREQ, AFLAG, RFLAG, FREQA                                    COMF        10
      INTEGER QUALITY, FERR, FTOT                                       COMF        11
************************************************************************COMF        12
************************************************************************COMF        13
************************************************************************COMR         1
***   COMMON FOR ROOM ARRAY CONTAINING ATTENUATION OF WALLS          ***COMR         2
************************************************************************COMR         3
      INTEGER RMAX                                                      COMR         4
      PARAMETER (RMAX = 20)                                             COMR         5
      COMMON /ROOMN/ ROOM(RMAX + 6, RMAX + 6), NROOMS, RAREA(RMAX)      COMR         6
      INTEGER NROOMS                                                    COMR         7
      REAL ROOM                                                         COMR         8
************************************************************************COMR         9
************************************************************************COMR        10
*                                                                       PROOM       10
      INTEGER R,C                                                       PROOM       11
*                                                                       PROOM       12
      PRINT*                                                            PROOM       13
      PRINT*,'      ATTENUATION (DB) BETWEEN ROOMS'                     PROOM       14
      PRINT*,'  AT FREQUENCY = ',FREQ,' HERTZ'                          PROOM       15
      PRINT*,'**********************************************************PROOM       16
     $*************'                                                    PROOM       17
      DO 10 R = 1,NROOMS                                                PROOM       18
        PRINT 1000,(ROOM(R,C), C = 1, NROOMS + 6)                       PROOM       19
   10 CONTINUE                                                          PROOM       20
      DO 20 R = NROOMS + 1 , NROOMS  + 6                                PROOM       21
        PRINT 1000, (ROOM(R,C), C = 1, NROOMS )                         PROOM       22
   20 CONTINUE                                                          PROOM       23
      PRINT*,'==========================================================PROOM       24
     $============='                                                    PROOM       25
 1000 FORMAT(1X,12(F8.3) )                                              PROOM       26
      RETURN                                                            PROOM       27
      END                                                               PROOM       28
```

--VARIABLE MAP--(LO=A)

-NAME---	ADDRESS--	BLOCK-----	PROPERTIES-------	TYPE---------	SIZE
AFLAG	2B	/INITILN/		REAL	
BLDG	0B	/INITILC/		CHAR*5	
C	210B			INTEGER	
FERR	66B	/INITILN/		INTEGER	
FREQ	0B	/INITILN/		REAL	
FREQA	4B	/INITILN/		REAL	50
FTOT	67B	/INITILN/		INTEGER	
NROOMS	1244B	/ROOMN/		INTEGER	
QUALITY	1B	/INITILN/		INTEGER	
R	207B			INTEGER	

```
 RAREA    1245B  /ROOMN/                    REAL          20
 RFLAG       3B  /INITILN/                  REAL
 ROOM        0B  /ROOMN/                    REAL         676


--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE------------------------VALUE

 FMAX    INTEGER                        50
 RMAX    INTEGER                        20


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

    10  INACTIVE   DO-TERM        41
    20  INACTIVE   DO-TERM        44
  1000    154B     FORMAT         47


--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

 PROOM       5B     0


--STATISTICS--

 PROGRAM-UNIT LENGTH            217B =  143
 CM LABELLED COMMON LENGTH     1362B =  754
 CM STORAGE USED              61000B =  25088
 COMPILE TIME                 0.080 SECONDS
```

```
      SUBROUTINE PTDB                                                   PTDB      1
************************************************************************PTDB      2
*  PRINT SUMMARY OF THE ATTENUATION OF THE DOORS AND WINDOWS            PTDB      3
************************************************************************PTDB      4
************************************************************************COMT      1
***    COMMON FOR DATABASE OF TYPES OF DOORS AND WINDOWS             ***COMT      2
************************************************************************COMT      3
      INTEGER TMAX                                                      COMT      4
      PARAMETER (TMAX=35)                                               COMT      5
      COMMON /TYPEN/TDIM(TMAX,4),TTOT,TDB2(TMAX,2),TDBTOT,TERR          COMT      6
      COMMON /TYPEC/TYPE(TMAX,3),TDB1(TMAX)                             COMT      7
      INTEGER TTOT,TDBTOT,TERR                                          COMT      8
      REAL TDIM,TDB2                                                    COMT      9
      CHARACTER * 3 TYPE,TDB1                                           COMT     10
*==================================================                    COMT     11
* DESCRIPTION OF ARRAYS                                                 COMT     12
*==================================================                    COMT     13
*   ID        MATERIAL    FRAME MATERIAL                                COMT     14
*--------------------------------------------------                    COMT     15
*TYPE(X,1)   TYPE(X,2)   TYPE(X,3)                                     COMT     16
* A3          A3          A3                                            COMT     17
*==================================================                    COMT     18
* HEIGHT      WIDTH       LAYER       DISTANCE                          COMT     19
*                         THICKNESS   ABOVE FLOOR                       COMT     20
*--------------------------------------------------                    COMT     21
* TDIM(X,1)   TDIM(X,2)   TDIM(X,3)   TDIM(X,4)                         COMT     22
*  F8.2        F8.2        F8.2        F8.2                             COMT     23
*==================================================                    COMT     24
*  ID       ATTENUATION    AREA                                         COMT     25
* -------------------------------------------------                    COMT     26
* TDB1(X)    TDB2(X,1)    TDB2(X,2)                                     COMT     27
*  A3           E9.3         E9.3                                       COMT     28
************************************************************************COMT     29
************************************************************************COMT     30
      INTEGER R,C                                                       PTDB      6
      CHARACTER * 3 ID                                                  PTDB      7
      PRINT *                                                           PTDB      8
      PRINT*,'DOOR AND WINDOW SUMMARY'                                  PTDB      9
      PRINT*,'**********************************'                       PTDB     10
      PRINT*,'ID     ATTENUATION     AREA'                              PTDB     11
      PRINT*,'=================================='                       PTDB     12
      DO 10 R = 1 , TDBTOT                                              PTDB     13
      PRINT 1000,TDB1(R),(TDB2(R,C),C=1,2)                              PTDB     14
10    CONTINUE                                                          PTDB     15
      PRINT*,'=================================='                       PTDB     16
1000  FORMAT (1X,A3,5X,F8.2,5X,F6.2)                                    PTDB     17
      RETURN                                                            PTDB     18
      END                                                               PTDB     19
```

```
--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  C         144B                             INTEGER
  ID        NONE               UNUSED/*S*    CHAR*3
  R         143B                             INTEGER
  TDBTOT    323B  /TYPEN/                    INTEGER
  TDB1       37B  /TYPEC/                    CHAR*3          35
  TDB2      215B  /TYPEN/                    REAL            70
  TDIM        0B  /TYPEN/                    REAL           140
  TERR      324B  /TYPEN/                    INTEGER
  TTOT      214B  /TYPEN/                    INTEGER
  TYPE        0B  /TYPEC/                    CHAR*3         105
```

```
--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE------------------------VALUE

  TMAX    INTEGER                        35


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

     10  INACTIVE   DO-TERM        44
   1000     107B    FORMAT         46


--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  PTDB        5B     0


--STATISTICS--

  PROGRAM-UNIT LENGTH            151B =  105
  CM LABELLED COMMON LENGTH      377B =  255
  CM STORAGE USED              61000B =  25088
  COMPILE TIME                 0.060 SECONDS
```

```
      SUBROUTINE PTYPE                                                  PTYPE
*CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCPTYPE
*CCC                                                                 CCCPTYPE
*CCC   PRINT OUT THE CONTENTS OF THE "TYPE" AND "TDIM" ARRAYS        CCCPTYPE
*CCC                                                                 CCCPTYPE
*CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCPTYPE
************************************************************************PTYPE
************************************************************************COMT
***   COMMON FOR DATABASE OF TYPES OF DOORS AND WINDOWS              ***COMT
************************************************************************COMT
      INTEGER TMAX                                                      COMT
      PARAMETER (TMAX=35)                                               COMT
      COMMON /TYPEN/TDIM(TMAX,4),TTOT,TDB2(TMAX,2),TDBTOT,TERR          COMT
      COMMON /TYPEC/TYPE(TMAX,3),TDB1(TMAX)                             COMT
      INTEGER TTOT,TDBTOT,TERR                                          COMT
      REAL TDIM,TDB2                                                    COMT
      CHARACTER * 3 TYPE,TDB1                                           COMT
*=================================================                      COMT
* DESCRIPTION OF ARRAYS                                                 COMT
*=================================================                      COMT
*   ID        MATERIAL    FRAME MATERIAL                                COMT
*-------------------------------------------------                      COMT
*TYPE(X,1)   TYPE(X,2)   TYPE(X,3)                                      COMT
* A3          A3          A3                                            COMT
*=================================================                      COMT
* HEIGHT      WIDTH       LAYER       DISTANCE                          COMT
*                         THICKNESS   ABOVE FLOOR                       COMT
*-------------------------------------------------                      COMT
* TDIM(X,1)   TDIM(X,2)   TDIM(X,3)   TDIM(X,4)                         COMT
*  F8.2        F8.2        F8.2        F8.2                             COMT
*=================================================                      COMT
*  ID       ATTENUATION    AREA                                         COMT
* ------------------------------------------------                      COMT
* TDB1(X)    TDB2(X,1)    TDB2(X,2)                                     COMT
*   A3          E9.3         E9.3                                       COMT
************************************************************************COMT
************************************************************************COMT
*                                                                       PTYPE
      INTEGER  R, C                                                     PTYPE
*                                                                       PTYPE
      PRINT *                                                           PTYPE
      PRINT *,'                 DOOR AND WINDOW PARAMETERS'             PTYPE
      PRINT *,'**** ***************************************************'PTYPE
      PRINT *,' ID   MATERIAL FRAME   HEIGHT WIDTH  LAYER     DISTANCE' PTYPE
      PRINT *,'                 MATERIAL                THICKNESS ABOVE FLR'PTYPE
      PRINT *,'==== ==================================================='PTYPE
      DO 10 R = 1,TTOT                                                  PTYPE
        PRINT 1000,(TYPE(R,C),C=1,3),(TDIM(R,C),C=1,4)                  PTYPE
   10 CONTINUE                                                          PTYPE
      PRINT *,'========================================================'PTYPE
 1000 FORMAT (2X,A3,4X,A3,6X,A3,4(1X,F7.2))                             PTYPE
      RETURN                                                            PTYPE
      END                                                               PTYPE
```

```
--VARIABLE MAP--(LO=A)
-NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

 C         217B                             INTEGER
 R         216B                             INTEGER
 TDBTOT    323B  /TYPEN/                    INTEGER
 TDB1       37B  /TYPEC/                    CHAR*3          35
 TDB2      215B  /TYPEN/                    REAL            70
 TDIM        0B  /TYPEN/                    REAL           140
```

```
 TERR       324B  /TYPEN/                         INTEGER
 TTOT       214B  /TYPEN/                         INTEGER
 TYPE         0B  /TYPEC/                         CHAR*3          105


--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE------------------------VALUE

  TMAX    INTEGER                         35


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

     10  INACTIVE   DO-TERM        49
   1000     152B    FORMAT         51


--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  PTYPE        5B      0


--STATISTICS--

  PROGRAM-UNIT LENGTH            225B =  149
  CM LABELLED COMMON LENGTH      377B =  255
  CM STORAGE USED              61000B =  25088
  COMPILE TIME                 0.069 SECONDS
```

```
      SUBROUTINE PWALL                                                  PWALL      1
*****************************************************                   PWALL      2
*** PRINT OUT THE CONTENTS OF THE WALL AND WDIM ARRAYS                  PWALL      3
*****************************************************                   PWALL      4
*                                                                       PWALL      5
************************************************************************COMW       1
***   COMMON FOR DATABASE OF WALL PARAMETERS                         ***COMW       2
************************************************************************COMW       3
      INTEGER WMAX                                                      COMW       4
      PARAMETER (WMAX = 75)                                             COMW       5
      COMMON /WALLN/ WDIM(WMAX,3), WTOT, WERR                           COMW       6
      COMMON /WALLC/ WALL(WMAX,4)                                       COMW       7
      INTEGER WTOT,WERR                                                 COMW       8
      REAL WDIM                                                         COMW       9
      CHARACTER *3 WALL                                                 COMW      10
* ==================================                                    COMW      11
** DESCRIPTION OF ARRAYS                                                COMW      12
* ==================================                                    COMW      13
*    WALL IDENTIFICATION                                                COMW      14
* ----------------------------------                                    COMW      15
* DIRECTION    FROM       TO                                            COMW      16
*              ROOM       ROOM                                          COMW      17
* ----------------------------------                                    COMW      18
* WALL(X,1)   WALL(X,2)   WALL(X,3)                                     COMW      19
*  A3           A3          A3                                          COMW      20
* ============================================================          COMW      21
*        WALL PARAMETERS                                                COMW      22
* ------------------------------------------------------------          COMW      23
* MATERIAL    HEIGHT      WIDTH       LAYER THICKNESS                   COMW      24
* ------------------------------------------------------------          COMW      25
* WALL(X,4)   WDIM(X,1)   WDIM(X,2)   WDIM(X,3)                         COMW      26
*  A3         F8.2        F8.2        F8.2                              COMW      27
************************************************************************COMW      28
************************************************************************COMW      29
*                                                                       PWALL      7
      INTEGER R, C                                                      PWALL      8
*                                                                       PWALL      9
      PRINT*                                                            PWALL     10
      PRINT *,'WALL IDENTIFICATION              WALL PARAMETERS'        PWALL     11
      PRINT *,'******************* ************************************'PWALL     12
      PRINT *,' DIR  FROM TO         MATERIAL HEIGHT  WIDTH   THICKNESS'PWALL     13
      PRINT *,'=================== ===================================='PWALL     14
      DO 10 R = 1,WTOT                                                  PWALL     15
        PRINT 1000,(WALL(R,C),C=1,4),(WDIM(R,C),C=1,3)                  PWALL     16
   10 CONTINUE                                                          PWALL     17
      PRINT *,'========================================================'PWALL     18
 1000 FORMAT (1X,3(2X,A3),10X,A3,1X,3(1X,F7.2))                         PWALL     19
      RETURN                                                            PWALL     20
      END                                                               PWALL     21
```

--VARIABLE MAP--(LO=A)

-NAME---	ADDRESS--	BLOCK-----	PROPERTIES-------	TYPE---------	SIZE
C	205B			INTEGER	
R	204B			INTEGER	
WALL	0B	/WALLC/		CHAR*3	300
WDIM	0B	/WALLN/		REAL	225
WERR	342B	/WALLN/		INTEGER	
WTOT	341B	/WALLN/		INTEGER	

```
--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE------------------------VALUE

  WMAX    INTEGER                        75


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

     10  INACTIVE   DO-TERM        45
   1000    142B     FORMAT         47


--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  PWALL       5B     0


--STATISTICS--

  PROGRAM-UNIT LENGTH             213B =  139
  CM LABELLED COMMON LENGTH       475B =  317
  CM STORAGE USED               61000B =  25088
  COMPILE TIME                  0.063 SECONDS
```

```
      REAL FUNCTION RCOEF (MATID,FREQ,RFLAG)                              RCOEF     1
*[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[RCOEF     2
*[[[                                                                 [[[RCOEF     3
*[[[   GIVEN THE MATERIAL AND THE FREQUENCY, THIS FUNCTION RETURNS   [[[RCOEF     4
*[[[   THE REFLECTION COEFFICIENT                                    [[[RCOEF     5
*[[[                                                                 [[[RCOEF     6
*[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[RCOEF     7
************************************************************************RCOEF     8
*   FREQ IS IN HERTZ                                                    RCOEF     9
*   HIFREQ,LOFREQ, AND F ARE IN LOG ( HERTZ )                           RCOEF    10
*   RFLAG RANGES FROM 0 TO 100 AND DETERMINES HOW MUCH OF THE QUALITY   RCOEF    11
*   FACTOR IS APPLIED TO THE REFLECTION COEFFICIENT VALUE.              RCOEF    12
************************************************************************RCOEF    13
************************************************************************COMM      1
***   COMMON FOR DATABASE OF MATERIAL PROPERTIES                     ***COMM      2
************************************************************************COMM      3
      INTEGER MMAX                                                      COMM      4
      PARAMETER (MMAX=100)                                              COMM      5
      COMMON /MATN/ MATTEN(MMAX,7), MRCOEF(MMAX,7), QA(MMAX), QR(MMAX), COMM      6
     $              MFREQ(MMAX,7), MERR, MTOT                           COMM      7
      COMMON /MATC/MAT(MMAX),MATDESC(MMAX)                              COMM      8
      INTEGER MTOT, MERR                                                COMM      9
      REAL MATTEN, MRCOEF, MFREQ, QA, QR                                COMM     10
      CHARACTER * 3  MAT                                                COMM     11
      CHARACTER * 70 MATDESC                                            COMM     12
************************************************************************COMM     13
************************************************************************COMM     14
**************************************************                      RCOEF    15
*   DECLARATION OF VARIABLES                                            RCOEF    16
**************************************************                      RCOEF    17
      REAL FREQ,FRAC,MINFREQ,MAXFREQ,LOFREQ,HIFREQ,LORCOEF,HIRCOEF,F    RCOEF    18
      INTEGER R,C,RINDEX,CINDEX                                         RCOEF    19
      LOGICAL FOUND,EXACT                                               RCOEF    20
      CHARACTER *3 MATID                                                RCOEF    21
**************************************************                      RCOEF    22
*   FIND ROW INDEX OF MATERIAL                                          RCOEF    23
**************************************************                      RCOEF    24
      FOUND = .FALSE.                                                   RCOEF    25
      DO 10 R = 1, MMAX                                                 RCOEF    26
         IF ( MAT(R) .EQ. MATID ) THEN                                  RCOEF    27
            FOUND = .TRUE.                                              RCOEF    28
            RINDEX = R                                                  RCOEF    29
         END IF                                                         RCOEF    30
10    CONTINUE                                                          RCOEF    31
      IF ( .NOT. FOUND ) THEN                                           RCOEF    32
         IERR = 3                                                       RCOEF    33
         CALL ERROR (IERR)                                              RCOEF    34
      END IF                                                            RCOEF    35
**************************************************                      RCOEF    36
*   TEST FOR FREQUENCY OUT OF RANGE                                     RCOEF    37
**************************************************                      RCOEF    38
      MINFREQ = MFREQ (RINDEX,1)                                        RCOEF    39
      MAXFREQ = MFREQ (RINDEX,7)                                        RCOEF    40
      IF ( FREQ .LT. MINFREQ .OR. FREQ .GT. MAXFREQ ) THEN              RCOEF    41
         IERR = 2                                                       RCOEF    42
         CALL ERROR (IERR)                                              RCOEF    43
      END IF                                                            RCOEF    44
**************************************************                      RCOEF    45
*   IF THE EXACT FREQUENCY IS IN THE TABLE, THEN                        RCOEF    46
*   USE THE REFLECTION COEFFICIENT VALUE WITHOUT INTERPOLATION.         RCOEF    47
**************************************************                      RCOEF    48
      DO 20 C= 1,7                                                      RCOEF    49
         EXACT = .FALSE.                                                RCOEF    50
         IF ( FREQ .EQ. MFREQ (RINDEX,C) ) THEN                         RCOEF    51
```

```
                 EXACT = .TRUE.                                          RCOEF      52
                 CINDEX = C                                              RCOEF      53
                 RCOEF = MRCOEF (RINDEX,CINDEX)                          RCOEF      54
                 RCOEF = RCOEF * ( 1 +  RFLAG / 100 )                    RCOEF      55
              END IF                                                     RCOEF      56
   20    CONTINUE                                                        RCOEF      57
*****************************************************                    RCOEF      58
*   INTERPOLATE REFLECTION COEFFICIENT VALUES IF EXACT FREQUENCY IS      RCOEF      59
*   NOT IN THE FREQUENCY/REFLECTION COEFFICIENT ARRAYS.                  RCOEF      60
*****************************************************                    RCOEF      61
         IF ( .NOT. EXACT ) THEN                                         RCOEF      62
            DO 30 C=1,6                                                  RCOEF      63
               IF ( FREQ .GT. MFREQ (RINDEX,C) .AND.                     RCOEF      64
     $              FREQ .LT. MFREQ (RINDEX,C+1) )  THEN                 RCOEF      65
                  CINDEX = C                                             RCOEF      66
               END IF                                                    RCOEF      67
   30       CONTINUE                                                     RCOEF      68
            F = ALOG10 ( FREQ )                                          RCOEF      69
            LOFREQ = ALOG10 ( MFREQ (RINDEX, CINDEX) )                   RCOEF      70
            HIFREQ = ALOG10 ( MFREQ (RINDEX, CINDEX + 1) )               RCOEF      71
            LORCOEF = MRCOEF (RINDEX,CINDEX)                             RCOEF      72
            HIRCOEF = MRCOEF (RINDEX, CINDEX + 1)                        RCOEF      73
            FRAC = (F - LOFREQ) / (HIFREQ - LOFREQ)                      RCOEF      74
            RCOEF = LORCOEF + (FRAC * (HIRCOEF - LORCOEF) )              RCOEF      75
            RCOEF = RCOEF * ( 1 +  RFLAG / 100 )                         RCOEF      76
         END IF                                                          RCOEF      77
         RETURN                                                          RCOEF      78
         END                                                             RCOEF      79
```

--VARIABLE MAP--(LO=A)

-NAME---	ADDRESS--	BLOCK-----	PROPERTIES-------	TYPE---------	SIZE
C	254B			INTEGER	
CINDEX	256B			INTEGER	
EXACT	260B			LOGICAL	
F	252B			REAL	
FOUND	257B			LOGICAL	
FRAC	243B			REAL	
FREQ	2	DUMMY-ARG		REAL	
HIFREQ	247B			REAL	
HIRCOEF	251B			REAL	
IERR	262B			INTEGER	
LOFREQ	246B			REAL	
LORCOEF	250B			REAL	
MAT	0B	/MATC/		CHAR*3	100
MATDESC	36B	/MATC/		CHAR*70	100
MATID	1	DUMMY-ARG		CHAR*3	
MATTEN	0B	/MATN/		REAL	700
MAXFREQ	245B			REAL	
MERR	4374B	/MATN/		INTEGER	
MFREQ	3100B	/MATN/		REAL	700
MINFREQ	244B			REAL	
MRCOEF	1274B	/MATN/		REAL	700
MTOT	4375B	/MATN/		INTEGER	
QA	2570B	/MATN/		REAL	100
QR	2734B	/MATN/		REAL	100
R	253B			INTEGER	
RCOEF	242B			REAL	
RFLAG	3	DUMMY-ARG		REAL	
RINDEX	255B			INTEGER	

```
--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE------------------------VALUE

 MMAX     INTEGER                         100


--PROCEDURES--(LO=A)
 -NAME------TYPE--------ARGS------CLASS-----

 ALOG10    REAL            1      INTRINSIC
 ERROR                     1      SUBROUTINE


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

    10  INACTIVE   DO-TERM        44
    20  INACTIVE   DO-TERM        70
    30  INACTIVE   DO-TERM        81


--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

 RCOEF       6B     3


--STATISTICS--

 PROGRAM-UNIT LENGTH            267B =  183
 CM LABELLED COMMON LENGTH     5730B =  3032
 CM STORAGE USED              61000B =  25088
 COMPILE TIME                 0.127 SECONDS
```

```
      SUBROUTINE SRCHTDB (ID, OATTEN,OAREA)                              SRCHTDB    1
*[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[SRCHTDB    2
*[[[                                                                 [[[SRCHTDB    3
*[[[  GIVEN AN OPENING ID, THIS SUBROUTINE RETURNS ITS ATTENUATION  [[[SRCHTDB    4
*[[[  AND AREA.                                                      [[[SRCHTDB    5
*[[[                                                                 [[[SRCHTDB    6
*[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[SRCHTDB    7
************************************************************************COMT       1
***   COMMON FOR DATABASE OF TYPES OF DOORS AND WINDOWS              ***COMT       2
************************************************************************COMT       3
      INTEGER TMAX                                                      COMT       4
      PARAMETER (TMAX=35)                                               COMT       5
      COMMON /TYPEN/TDIM(TMAX,4),TTOT,TDB2(TMAX,2),TDBTOT,TERR          COMT       6
      COMMON /TYPEC/TYPE(TMAX,3),TDB1(TMAX)                             COMT       7
      INTEGER TTOT,TDBTOT,TERR                                          COMT       8
      REAL TDIM,TDB2                                                    COMT       9
      CHARACTER * 3 TYPE,TDB1                                           COMT      10
*================================================                       COMT      11
* DESCRIPTION OF ARRAYS                                                 COMT      12
*================================================                       COMT      13
*   ID        MATERIAL    FRAME MATERIAL                                COMT      14
*------------------------------------------------                       COMT      15
*TYPE(X,1)   TYPE(X,2)   TYPE(X,3)                                     COMT      16
* A3          A3          A3                                            COMT      17
*================================================                       COMT      18
* HEIGHT      WIDTH       LAYER       DISTANCE                          COMT      19
*                         THICKNESS   ABOVE FLOOR                       COMT      20
*------------------------------------------------                       COMT      21
* TDIM(X,1)   TDIM(X,2)   TDIM(X,3)   TDIM(X,4)                         COMT      22
*  F8.2        F8.2        F8.2        F8.2                             COMT      23
*================================================                       COMT      24
*  ID       ATTENUATION    AREA                                         COMT      25
* -----------------------------------------------                       COMT      26
* TDB1(X)    TDB2(X,1)    TDB2(X,2)                                     COMT      27
*   A3          E9.3         E9.3                                       COMT      28
************************************************************************COMT      29
************************************************************************COMT      30
      INTEGER R                                                         SRCHTDB    9
      REAL OAREA,OATTEN                                                 SRCHTDB   10
      CHARACTER *3 ID                                                   SRCHTDB   11
*                                                                       SRCHTDB   12
      DO 10 R = 1 , TDBTOT                                              SRCHTDB   13
      IF (TDB1(R) .EQ. ID) THEN                                         SRCHTDB   14
         OATTEN = TDB2(R,1)                                             SRCHTDB   15
         OAREA = TDB2(R,2)                                              SRCHTDB   16
         RETURN                                                         SRCHTDB   17
      END IF                                                            SRCHTDB   18
   10 CONTINUE                                                          SRCHTDB   19
      END                                                               SRCHTDB   20
```

```
--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  ID           1   DUMMY-ARG                  CHAR*3
  OAREA        3   DUMMY-ARG                  REAL
  OATTEN       2   DUMMY-ARG                  REAL
  R          65B                              INTEGER
  TDBTOT    323B  /TYPEN/                     INTEGER
  TDB1       37B  /TYPEC/                     CHAR*3          35
  TDB2      215B  /TYPEN/                     REAL            70
  TDIM        0B  /TYPEN/                     REAL           140
  TERR      324B  /TYPEN/                     INTEGER
  TTOT      214B  /TYPEN/                     INTEGER
```

```
 TYPE         0B  /TYPEC/                      CHAR*3        105


--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE------------------------VALUE

 TMAX     INTEGER                       35


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

    10  INACTIVE   DO-TERM        48


--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

 SRCHTDB      5B     3


--STATISTICS--

 PROGRAM-UNIT LENGTH             71B =  57
 CM LABELLED COMMON LENGTH      377B =  255
 CM STORAGE USED              61000B =  25088
 COMPILE TIME                 0.049 SECONDS
```

```
SUBROUTINE WARNING  74/175  OPT=0

      1        SUBROUTINE WARNING(ERR)                                             WARNING      1
      2        INTEGER ERR, ERRM                                                   WARNING      2
      3        CHARACTER*45 MESSAGE(20)                                            WARNING      3
      4        DATA MESSAGE( 1)/'"HOLE" DATA FILE DOES NOT EXIST FOR THIS BLDG'/ WARNING      4
      5        DATA MESSAGE( 2)/'FILE HANDLING PROBLEM ON "HOLE" DATA FILE    '/ WARNING      5
      6        DATA MESSAGE( 3)/'"MATTER" FILE DOES NOT EXIST FOR THIS BLDG   '/ WARNING      6
      7        DATA MESSAGE( 4)/'FILE HANDLING PROBLEM ON "MATTER FILE        '/ WARNING      7
      8        DATA MESSAGE( 5)/'"TYPE" DATA FILE DOES NOT EXIST FOR THIS BLDG'/ WARNING      8
      9        DATA MESSAGE( 6)/'FILE HANDLING PROBLEM ON "TYPE" FILE         '/ WARNING      9
     10        DATA MESSAGE( 7)/'"WALL" DATA FILE DOES NOT EXIST FOR THIS BLDG'/ WARNING     10
     11        DATA MESSAGE( 8)/'FILE HANDLING PROBLEM ON "WALL" FILE         '/ WARNING     11
     12        DATA MESSAGE( 9)/'HEIGHT AND WIDTH OF ROOM MISSING             '/ WARNING     12
     13        DATA MESSAGE(10)/'LENGTH OF ROOM IS MISSING                    '/ WARNING     13
     14        DATA MESSAGE(11)/'FREQ FILE DOES NOT EXIST FOR THIS BLDG       '/ WARNING     14
     15        DATA MESSAGE(12)/'FILE HANDLING PROBLEM WITH FREQ FILE         '/ WARNING     15
     16        DATA MESSAGE(13)/'WARNING CODE IS OUT OF RANGE                 '/ WARNING     16
     17        DATA MESSAGE(14)/'WARNING CODE IS OUT OF RANGE                 '/ WARNING     17
     18        DATA MESSAGE(15)/'WARNING CODE IS OUT OF RANGE                 '/ WARNING     18
     19        DATA MESSAGE(16)/'WARNING CODE IS OUT OF RANGE                 '/ WARNING     19
     20        DATA MESSAGE(17)/'WARNING CODE IS OUT OF RANGE                 '/ WARNING     20
     21        DATA MESSAGE(18)/'WARNING CODE IS OUT OF RANGE                 '/ WARNING     21
     22        DATA MESSAGE(19)/'WARNING CODE IS OUT OF RANGE                 '/ WARNING     22
     23        DATA MESSAGE(20)/'WARNING CODE IS OUT OF RANGE                 '/ WARNING     23
     24        ERRM=12                                                             WARNING     24
     25        IERR = ERR                                                          WARNING     25
     26        IF(ERR.GT.ERRM) IERR=20                                             WARNING     26
     27        WRITE(6,20)                                                         WARNING     27
     28        WRITE(6,10) ERR,MESSAGE(IERR)                                       WARNING     28
     29        WRITE(6,20)                                                         WARNING     29
     30 10     FORMAT(' ***WARNING NUMBER = ',I5,' ***  ',A45)                     WARNING     30
     31 20     FORMAT('      ')                                                    WARNING     31
     32        RETURN                                                              WARNING     32
     33        END                                                                 WARNING     33

--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  ERR         1   DUMMY-ARG                  INTEGER
  ERRM       60B                             INTEGER
  IERR      213B                             INTEGER
  MESSAGE    61B                             CHAR*45        20

--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

     10     34B    FORMAT          30
     20     42B    FORMAT          31

--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  WARNING     5B     1
```

```
SUBROUTINE WARNING  74/175  OPT=0

--I/O UNITS--(LO=A)
 -NAME--- PROPERTIES------------

  TAPE6   FMT/SEQ


--STATISTICS--

  PROGRAM-UNIT LENGTH            216B =  142
  CM STORAGE USED              61000B =  25088
  COMPILE TIME                 0.061 SECONDS
```

```
      SUBROUTINE SETUP                                                  SETUP       1
***********************************************************************COMR        1
***   COMMON FOR ROOM ARRAY CONTAINING ATTENUATION OF WALLS         ***COMR        2
***********************************************************************COMR        3
      INTEGER RMAX                                                      COMR        4
      PARAMETER (RMAX = 20)                                             COMR        5
      COMMON /ROOMN/ ROOM(RMAX + 6, RMAX + 6), NROOMS, RAREA(RMAX)      COMR        6
      INTEGER NROOMS                                                    COMR        7
      REAL ROOM                                                         COMR        8
***********************************************************************COMR        9
***********************************************************************COMR       10
*****************************************************************       COMJ        1
*                                                                       COMJ        2
* COMMON FOR EVALUATION OF ROOM MATRIX                                   COMJ        3
*                                                                       COMJ        4
*****************************************************************       COMJ        5
      COMMON /MAT/TMAT(RMAX,RMAX),ENERGY(RMAX),POWER(6),FTIME           COMJ        6
     +,SWR(RMAX,6),IDIR                                                 COMJ        7
      REAL TMAT ,ENERGY,POWER,SWR                                       COMJ        8
      LOGICAL FTIME                                                     COMJ        9
***********************************************************************COMD        1
*     COMMON FOR ABSORPTION AND REFLECTION COEFFICIENTS IN WALLS        COMD        2
***********************************************************************COMD        3
      COMMON /ROOMD/DDABS(RMAX + 6, RMAX + 6 ) ,DREFL, DREFLW           COMD        4
      REAL DDABS ,DREFL , DREFLW                                        COMD        5
***********************************************************************COMD        6
***********************************************************************COMD        7
      DATA FTIME /.TRUE./                                               SETUP       5
      IF (FTIME.EQV..FALSE.) GOTO 500                                   SETUP       6
C*****************************************************                  SETUP       7
C* CALCULATE DIAGONAL ELEMENTS                                          SETUP       8
C* ASSUME DIAGONAL ELEMENTS ARE INITIALLY ZERO                          SETUP       9
C*****************************************************                  SETUP      10
          DO 200 IR=1,NROOMS                                            SETUP      11
          DIAG =0.0                                                     SETUP      12
               DO 100 IC=1,NROOMS + 6                                   SETUP      13
  100          DIAG =DIAG + ROOM(IR,IC) + DDABS(IR,IC)                  SETUP      14
  200     ROOM(IR,IR) = -DIAG                                           SETUP      15
C****************************************************                   SETUP      16
C* SET FTIME FALSE                                                      SETUP      17
C****************************************************                   SETUP      18
      FTIME = .FALSE.                                                   SETUP      19
C****************************************************                   SETUP      20
                                                                        SETUP      21
C* NOW LOAD ROOM INTO TMAT                                              SETUP      22
C* NOTE THAT THE T MATRIX IS REFLECTED ABOUT THE DIAGONAL               SETUP      23
C*  WITH RESPECT TO THE ROOM MATRIX                                     SETUP      24
C****************************************************                   SETUP      25
  500     DO 600 IR = 1, NROOMS                                         SETUP      26
          DO 600 IC = 1, NROOMS                                         SETUP      27
  600     TMAT(IR,IC) = ROOM(IC,IR)                                     SETUP      28
      RETURN                                                            SETUP      29
      END                                                               SETUP      30
```

```
--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  DDABS       0B  /ROOMD/                    REAL           676
  DIAG      114B                             REAL
  DREFL    1244B  /ROOMD/                    REAL
  DREFLW   1245B  /ROOMD/                    REAL
  ENERGY    620B  /MAT/                      REAL            20
  FTIME     652B  /MAT/                      LOGICAL
```

```
 IC         115B                              INTEGER
 IDIR      1043B   /MAT/                      INTEGER
 IR         112B                              INTEGER
 NROOMS    1244B   /ROOMN/                    INTEGER
 POWER      644B   /MAT/                      REAL            6
 RAREA     1245B   /ROOMN/                    REAL           20
 ROOM         0B   /ROOMN/                    REAL          676
 SWR        653B   /MAT/                      REAL          120
 TMAT         0B   /MAT/                      REAL          400


--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE------------------------VALUE

 RMAX     INTEGER                        20


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

   100  INACTIVE   DO-TERM        37
   200  INACTIVE   DO-TERM        38
   500     53B                    49
   600  INACTIVE   DO-TERM        51


--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

 SETUP        5B     0


--STATISTICS--

 PROGRAM-UNIT LENGTH            123B =  83
 CM LABELLED COMMON LENGTH     3603B =  1923
 CM STORAGE USED              61000B =  25088
 COMPILE TIME                 0.074 SECONDS
```

```
C**        FUNCTION DETERM
C**
C**        PURPOSE
C**          CALCULATE THE DETERMINANT OF A SQUARE MATRIX
C**
C**        USAGE
C**          DET=DETERM(ARRAY,NORDER)
C**
C**        DESCRIPTION OF PARAMETERS
C**          ARRAY  - MATRIX
C**          NORDER - ORDER OF DETERMINANT(DEGREE OF MATRIX)
C**
C**        COMMENTS
C**          THIS SUBROUTINE DESTROYS THE INPUT MATRIX ARRAY
C**          THIS ROUTINE WAS MODIFIED SO THAT THE MAXIMUM
C**          VALUE IN THE TOP ROW IS MOVED OVER TO THE DIAGONAL
      FUNCTION DETERM(ARRAY,NORDER)
      DIMENSION ARRAY(20,*)
10    DETERM=1.
11    DO 50 K=1,NORDER
C**
C**        INTERCHANGE COLUMNS IF DIAGONAL ELEMENT IS ZERO
C**
21    AMAX=0.0
      JMAX=K
      DO 25 J=K,NORDER
      TMP=ARRAY(K,J)
      TMP=ABS(TMP)
      IF(TMP.LT.AMAX) GOTO 25
      AMAX=TMP
      JMAX=J
25    CONTINUE
      J=JMAX
      IF(J.GT.K) GOTO 31
      AATMP=ABS(ARRAY(K,K))
      IF (AATMP .GE. 1.0E-05) GOTO 41
30    DETERM =0.
      GOTO 60
31    DO 34 I=K,NORDER
      SAVE=ARRAY(I,J)
      ARRAY(I,J)=ARRAY(I,K)
34    ARRAY(I,K)=SAVE
      DETERM=-DETERM
C**
C**        SUBTRACT ROW K FROM LOWER ROWS TO GET DIAGONAL MATRIX
C**
41    DETERM=DETERM*ARRAY(K,K)
      IF(DETERM.EQ.0.0) RETURN
      IF(K-NORDER) 43,50,50
43    K1=K+1
      DO 46 I=K1,NORDER
      DO 46 J=K1,NORDER
46    ARRAY(I,J)=ARRAY(I,J)-ARRAY(I,K)*ARRAY(K,J)/ARRAY(K,K)
50    CONTINUE
60    RETURN
      END
```

```
--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  AATMP     222B                             REAL
  AMAX      215B                             REAL
  ARRAY       1   DUMMY-ARG                  REAL       ADJ-ARY
  DETERM    212B                             REAL
  I         223B                             INTEGER
  J         217B                             INTEGER
  JMAX      216B                             INTEGER
  K         213B                             INTEGER
  K1        226B                             INTEGER
  NORDER      2   DUMMY-ARG                  INTEGER
  SAVE      225B                             REAL
  TMP       221B                             REAL


--PROCEDURES--(LO=A)
 -NAME------TYPE--------ARGS------CLASS-----

  ABS       GENERIC        1      INTRINSIC


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF       -LABEL-ADDRESS-----PROPERTIES----DEF

     10 *NO REFS*                  19           34  INACTIVE   DO-TERM        42
     11 *NO REFS*                  20           41    124B                    47
     21 *NO REFS*                  24           43  INACTIVE                  50
     25     44B     DO-TERM        32           46  INACTIVE   DO-TERM        53
     30 *NO REFS*                  37           50    200B     DO-TERM        54
     31     71B                    39           60    205B                    55


--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  DETERM      6B     2


--STATISTICS--

  PROGRAM-UNIT LENGTH           233B =  155
  CM STORAGE USED             61000B =  25088
  COMPILE TIME                0.111 SECONDS
```

```
      SUBROUTINE ECALC                                                  ECALC   1
      DIMENSION PVECTOR(20)                                             ECALC   2
      REAL NUM                                                          ECALC   3
      LOGICAL TLOW                                                      ECALC   4
************************************************************************COMR    1
***   COMMON FOR ROOM ARRAY CONTAINING ATTENUATION OF WALLS          ***COMR    2
************************************************************************COMR    3
      INTEGER RMAX                                                      COMR    4
      PARAMETER (RMAX = 20)                                             COMR    5
      COMMON /ROOMN/ ROOM(RMAX + 6, RMAX + 6), NROOMS, RAREA(RMAX)      COMR    6
      INTEGER NROOMS                                                    COMR    7
      REAL ROOM                                                         COMR    8
************************************************************************COMR    9
************************************************************************COMR   10
****************************************************************        COMJ    1
*                                                                       COMJ    2
* COMMON FOR EVALUATION OF ROOM MATRIX                                  COMJ    3
*                                                                       COMJ    4
****************************************************************        COMJ    5
      COMMON /MAT/TMAT(RMAX,RMAX),ENERGY(RMAX),POWER(6),FTIME           COMJ    6
     +,SWR(RMAX,6),IDIR                                                 COMJ    7
      REAL TMAT ,ENERGY,POWER,SWR                                       COMJ    8
      LOGICAL FTIME                                                     COMJ    9
**************************************************                      ECALC   7
* CALCULATE THE ENERGY BALANCE IN THE ROOMS                             ECALC   8
**************************************************                      ECALC   9
*                                                                       ECALC  10
**************************************************                      ECALC  11
* CALCULATE THE DENOMINATOR TERM                                        ECALC  12
**************************************************                      ECALC  13
      CALL SETUP                                                        ECALC  14
      DENOM=DETERM(TMAT,NROOMS)                                         ECALC  15
      IF(DENOM) 100,50,100                                              ECALC  16
**************************************************                      ECALC  17
* ERROR # 4: DENOMINATOR = 0.                                           ECALC  18
**************************************************                      ECALC  19
   50 IERR = 4                                                          ECALC  20
      CALL ERROR(IERR)                                                  ECALC  21
      RETURN                                                            ECALC  22
**************************************************                      ECALC  23
* CALCULATE THE INPUT POWER VECTOR TO EACH ROOM                         ECALC  24
**************************************************                      ECALC  25
100   TLOW=.TRUE.                                                       ECALC  26
         DO 300 ICOL = 1,NROOMS                                         ECALC  27
         SUM = 0.0                                                      ECALC  28
              DO 200 IPWR = 1,6                                         ECALC  29
              IROW = IPWR + NROOMS                                      ECALC  30
  200         SUM = SUM + POWER(IPWR) * ROOM(IROW,ICOL)                 ECALC  31
         PVECTOR(ICOL) = - SUM                                          ECALC  32
300      IF (SUM.GT.(1.0E-06)) TLOW=.FALSE.                             ECALC  33
**************************************************                      ECALC  34
* CHECK IF INPUT POWER IS TOO LOW                                       ECALC  35
**************************************************                      ECALC  36
      IF (TLOW.NEQV..TRUE.) GOTO 350                                    ECALC  37
**************************************************                      ECALC  38
* INPUT TOO LOW                                                         ECALC  39
**************************************************                      ECALC  40
      DO 310 ICOL=1,NROOMS                                              ECALC  41
  310 ENERGY(ICOL)=1.0E-05                                              ECALC  42
      RETURN                                                            ECALC  43
**************************************************                      ECALC  44
* SET UP NUMERATORS                                                     ECALC  45
**************************************************                      ECALC  46
* RENEW TMATRIX                                                         ECALC  47
```

```
     65 *************************************************          ECALC     48
     66   350 DO 500 ICOL = 1,NROOMS                                ECALC     49
     67          CALL SETUP                                         ECALC     50
     68 *************************************************          ECALC     51
     69 * PUT PVECTOR INTO PROPER COLUMN                            ECALC     52
     70 *************************************************          ECALC     53
     71               DO 400 IROW = 1,NROOMS                        ECALC     54
     72   400         TMAT(IROW,ICOL) = PVECTOR(IROW)               ECALC     55
     73 *************************************************          ECALC     56
     74 * NOW CALCULATE THE ENERGY FOR THE ROOM REPRESENTED          ECALC     57
     75 * BY ICOL                                                   ECALC     58
     76 *************************************************          ECALC     59
     77          NUM = DETERM(TMAT,NROOMS)                          ECALC     60
     78          ENERGY(ICOL) = NUM/DENOM                           ECALC     61
     79   500 CONTINUE                                              ECALC     62
     80       RETURN                                                ECALC     63
     81       END                                                   ECALC     64
```

```
--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  DENOM     213B                               REAL
  ENERGY    620B   /MAT/                       REAL          20
  FTIME     652B   /MAT/                       LOGICAL
  ICOL      215B                               INTEGER
  IDIR     1043B   /MAT/                       INTEGER
  IERR      214B                               INTEGER
  IPWR      220B                               INTEGER
  IROW      222B                               INTEGER
  NROOMS   1244B   /ROOMN/                     INTEGER
  NUM       211B                               REAL
  POWER     644B   /MAT/                       REAL           6
  PVECTOR   165B                               REAL          20
  RAREA    1245B   /ROOMN/                     REAL          20
  ROOM        0B   /ROOMN/                     REAL         676
  SUM       217B                               REAL
  SWR       653B   /MAT/                       REAL         120
  TLOW      212B                               LOGICAL
  TMAT        0B   /MAT/                       REAL         400


--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE------------------------VALUE

  RMAX    INTEGER                        20


--PROCEDURES--(LO=A)
 -NAME------TYPE--------ARGS------CLASS-----

  DETERM    REAL           2      FUNCTION
  ERROR                    1      SUBROUTINE
  SETUP                    0      SUBROUTINE


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF       -LABEL-ADDRESS-----PROPERTIES----DEF

    50  INACTIVE                   37          310  INACTIVE   DO-TERM        59
   100     22B                     43          350     107B                   66
   200  INACTIVE   DO-TERM         48          400  INACTIVE   DO-TERM        72
   300  INACTIVE   DO-TERM         50          500  INACTIVE   DO-TERM        79
```

```
--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  ECALC       5B      0


--STATISTICS--

  PROGRAM-UNIT LENGTH            230B =   152
  CM LABELLED COMMON LENGTH     2335B =  1245
  CM STORAGE USED              61000B = 25088
  COMPILE TIME                 0.101 SECONDS
```

```
      SUBROUTINE PPWR                                                   PPWR       1
***********************************************************************COMF       1
*** COMMON FOR INITIAL PARAMETERS                                    ***COMF       2
***********************************************************************COMF       3
      INTEGER FMAX                                                      COMF       4
      PARAMETER (FMAX = 50)                                             COMF       5
      COMMON /INITILN/ FREQ, QUALITY, AFLAG, RFLAG, FREQA(FMAX), FERR,  COMF       6
     $                 FTOT                                             COMF       7
      COMMON /INITILC/ BLDG                                             COMF       8
      CHARACTER * 5 BLDG                                                COMF       9
      REAL FREQ, AFLAG, RFLAG, FREQA                                    COMF      10
      INTEGER QUALITY, FERR, FTOT                                       COMF      11
***********************************************************************COMF      12
***********************************************************************COMF      13
***********************************************************************COMR       1
***   COMMON FOR ROOM ARRAY CONTAINING ATTENUATION OF WALLS          ***COMR       2
***********************************************************************COMR       3
      INTEGER RMAX                                                      COMR       4
      PARAMETER (RMAX = 20)                                             COMR       5
      COMMON /ROOMN/ ROOM(RMAX + 6, RMAX + 6), NROOMS, RAREA(RMAX)      COMR       6
      INTEGER NROOMS                                                    COMR       7
      REAL ROOM                                                         COMR       8
***********************************************************************COMR       9
***********************************************************************COMR      10
****************************************************************        COMJ       1
*                                                                       COMJ       2
* COMMON FOR EVALUATION OF ROOM MATRIX                                  COMJ       3
*                                                                       COMJ       4
****************************************************************        COMJ       5
      COMMON /MAT/TMAT(RMAX,RMAX),ENERGY(RMAX),POWER(6),FTIME           COMJ       6
     +,SWR(RMAX,6),IDIR                                                 COMJ       7
      REAL TMAT ,ENERGY,POWER,SWR                                       COMJ       8
      LOGICAL FTIME                                                     COMJ       9
      REAL DB                                                           PPWR       5
      WRITE(*,20) FREQ                                                  PPWR       6
   20 FORMAT (/"    POWER BY DIRECTION 1-6 AT A FREQUENCY OF",1PE10.3," PPWR       7
     +HZ")                                                              PPWR       8
      WRITE (*,30) (POWER(I),I=1,6)                                     PPWR       9
   30 FORMAT ( "         1          2          3          4          5  PPWR      10
     + 6", /," *********************************************************PPWR      11
     +*****",/, 6(3X,F7.2),/,)                                          PPWR      12
      WRITE (*,40)                                                      PPWR      13
   40 FORMAT("  ROOM          ENERGY          DB ",/,                   PPWR      14
     +  "****************************************")                     PPWR      15
      DO 100 ICOL=1,NROOMS                                              PPWR      16
      DB=10.0 * ALOG10 ( ENERGY( ICOL) / 10. )                          PPWR      17
  100 WRITE(*,50) ICOL, ENERGY (ICOL), DB                               PPWR      18
   50 FORMAT( 3X,I3,5X,F10.2,5X,F10.2)                                  PPWR      19
      RETURN                                                            PPWR      20
      END                                                               PPWR      21
```

--VARIABLE MAP--(LO=A)

NAME	ADDRESS	BLOCK	PROPERTIES	TYPE	SIZE
AFLAG	2B	/INITILN/		REAL	
BLDG	0B	/INITILC/		CHAR*5	
DB	147B			REAL	
ENERGY	620B	/MAT/		REAL	20
FERR	66B	/INITILN/		INTEGER	
FREQ	0B	/INITILN/		REAL	
FREQA	4B	/INITILN/		REAL	50
FTIME	652B	/MAT/		LOGICAL	
FTOT	67B	/INITILN/		INTEGER	

```
 I          150B                               INTEGER
 ICOL       151B                               INTEGER
 IDIR      1043B  /MAT/                        INTEGER
 NROOMS    1244B  /ROOMN/                      INTEGER
 POWER      644B  /MAT/                        REAL             6
 QUALITY      1B  /INITILN/                    INTEGER
 RAREA     1245B  /ROOMN/                      REAL            20
 RFLAG        3B  /INITILN/                    REAL
 ROOM         0B  /ROOMN/                      REAL           676
 SWR        653B  /MAT/                        REAL           120
 TMAT         0B  /MAT/                        REAL           400


--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE-------------------------VALUE

 FMAX    INTEGER                         50
 RMAX    INTEGER                         20


--PROCEDURES--(LO=A)
 -NAME------TYPE--------ARGS------CLASS-----

 ALOG10    REAL            1      INTRINSIC


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

    20      55B     FORMAT          36
    30      65B     FORMAT          39
    40     105B     FORMAT          43
    50     117B     FORMAT          48
   100  INACTIVE    DO-TERM         47


--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

 PPWR        5B     0


--STATISTICS--

 PROGRAM-UNIT LENGTH             155B =  109
 CM LABELLED COMMON LENGTH      2426B =  1302
 CM STORAGE USED              61000B =  25088
 COMPILE TIME                 0.075 SECONDS
```

```
      SUBROUTINE PTMAT                                                  PTMAT     1
C** PRINTOUT THE CONTENTS OF THE ROOM MATRIX                            PTMAT     2
************************************************************************COMF      1
*** COMMON FOR INITIAL PARAMETERS                                    ***COMF      2
************************************************************************COMF      3
      INTEGER FMAX                                                      COMF      4
      PARAMETER (FMAX = 50)                                             COMF      5
      COMMON /INITILN/ FREQ, QUALITY, AFLAG, RFLAG, FREQA(FMAX), FERR,  COMF      6
     $                 FTOT                                             COMF      7
      COMMON /INITILC/ BLDG                                             COMF      8
      CHARACTER * 5 BLDG                                                COMF      9
      REAL FREQ, AFLAG, RFLAG, FREQA                                    COMF     10
      INTEGER QUALITY, FERR, FTOT                                       COMF     11
************************************************************************COMF     12
************************************************************************COMF     13
************************************************************************COMR      1
***   COMMON FOR ROOM ARRAY CONTAINING ATTENUATION OF WALLS          ***COMR      2
************************************************************************COMR      3
      INTEGER RMAX                                                      COMR      4
      PARAMETER (RMAX = 20)                                             COMR      5
      COMMON /ROOMN/ ROOM(RMAX + 6, RMAX + 6), NROOMS, RAREA(RMAX)      COMR      6
      INTEGER NROOMS                                                    COMR      7
      REAL ROOM                                                         COMR      8
************************************************************************COMR      9
************************************************************************COMR     10
*****************************************************************       COMJ      1
*                                                                       COMJ      2
* COMMON FOR EVALUATION OF ROOM MATRIX                                  COMJ      3
*                                                                       COMJ      4
*****************************************************************       COMJ      5
      COMMON /MAT/TMAT(RMAX,RMAX),ENERGY(RMAX),POWER(6),FTIME           COMJ      6
     +,SWR(RMAX,6),IDIR                                                 COMJ      7
      REAL TMAT ,ENERGY,POWER,SWR                                       COMJ      8
      LOGICAL FTIME                                                     COMJ      9
      INTEGER R,C                                                       PTMAT     6
      PRINT*                                                            PTMAT     7
      PRINT*,'     TMAT MATRIX VALUES '                                 PTMAT     8
      PRINT*,'  AT FREQUENCY = ',FREQ,' HERTZ'                          PTMAT     9
      PRINT*,'**********************************************************PTMAT     10
     +*************'                                                    PTMAT     11
      DO 10 R = 1,NROOMS                                                PTMAT     12
      PRINT 100,(TMAT(R,C), C = 1, NROOMS )                             PTMAT     13
   10 CONTINUE                                                          PTMAT     14
      PRINT*,'==========================================================PTMAT     15
     +============='                                                    PTMAT     16
  100 FORMAT(1X,12(E12.6) )                                             PTMAT     17
      RETURN                                                            PTMAT     18
      END                                                               PTMAT     19
```

```
--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  AFLAG       2B  /INITILN/                  REAL
  BLDG        0B  /INITILC/                  CHAR*5
  C         146B                             INTEGER
  ENERGY    620B  /MAT/                      REAL              20
  FERR       66B  /INITILN/                  INTEGER
  FREQ        0B  /INITILN/                  REAL
  FREQA       4B  /INITILN/                  REAL              50
  FTIME     652B  /MAT/                      LOGICAL
  FTOT       67B  /INITILN/                  INTEGER
  IDIR     1043B  /MAT/                      INTEGER
  NROOMS   1244B  /ROOMN/                    INTEGER
```

```
 POWER      644B  /MAT/                        REAL          6
 QUALITY      1B  /INITILN/                    INTEGER
 R          145B                               INTEGER
 RAREA     1245B  /ROOMN/                      REAL         20
 RFLAG        3B  /INITILN/                    REAL
 ROOM         0B  /ROOMN/                      REAL        676
 SWR        653B  /MAT/                        REAL        120
 TMAT         0B  /MAT/                        REAL        400


--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE-----------------------VALUE

 PMAX    INTEGER                        50
 RMAX    INTEGER                        20


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

    10  INACTIVE   DO-TERM        43
   100     113B    FORMAT         46


--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

 PTMAT       5B      0


--STATISTICS--

 PROGRAM-UNIT LENGTH            153B =  107
 CM LABELLED COMMON LENGTH     2426B =  1302
 CM STORAGE USED              61000B =  25088
 COMPILE TIME                 0.068 SECONDS
```

```
      SUBROUTINE DFACTOR                                                DFACTOR      1
************************************************************************COMF         1
*** COMMON FOR INITIAL PARAMETERS                                    ***COMF         2
************************************************************************COMF         3
      INTEGER FMAX                                                      COMF         4
      PARAMETER (FMAX = 50)                                             COMF         5
      COMMON /INITILN/ FREQ, QUALITY, AFLAG, RFLAG, FREQA(FMAX), FERR,  COMF         6
     $                  FTOT                                            COMF         7
      COMMON /INITILC/ BLDG                                             COMF         8
      CHARACTER * 5 BLDG                                                COMF         9
      REAL FREQ, AFLAG, RFLAG, FREQA                                    COMF        10
      INTEGER QUALITY, FERR, FTOT                                       COMF        11
************************************************************************COMF        12
************************************************************************COMF        13
************************************************************************COMH         1
***   COMMON FOR DATABASE OF LOCATIONS OF DOORS AND WINDOWS          ***COMH         2
************************************************************************COMH         3
      INTEGER HMAX                                                      COMH         4
      PARAMETER (HMAX = 35)                                             COMH         5
      COMMON /HOLEN/ HTOT, HERR                                         COMH         6
      COMMON /HOLEC/ HOLE(HMAX,4)                                       COMH         7
      INTEGER HTOT, HERR                                                COMH         8
      CHARACTER * 3 HOLE                                                COMH         9
* ==================================================                    COMH        10
* DESCRIPTION OF ARRAYS                                                 COMH        11
* ==================================================                    COMH        12
*     ROOM IDENTIFICATION             APERTURE ID                       COMH        13
* ------------------------------------                                  COMH        14
* DIRECTION    FROM ROOM     TO ROOM                                    COMH        15
* --------------------------------------------------                    COMH        16
* HOLE(X,1)    HOLE(X,2)     HOLE(X,3)    HOLE(X,4)                     COMH        17
*   A3            A3            A3            A3                        COMH        18
************************************************************************COMH        19
************************************************************************COMH        20
************************************************************************COMT         1
***   COMMON FOR DATABASE OF TYPES OF DOORS AND WINDOWS              ***COMT         2
************************************************************************COMT         3
      INTEGER TMAX                                                      COMT         4
      PARAMETER (TMAX=35)                                               COMT         5
      COMMON /TYPEN/TDIM(TMAX,4),TTOT,TDB2(TMAX,2),TDBTOT,TERR          COMT         6
      COMMON /TYPEC/TYPE(TMAX,3),TDB1(TMAX)                             COMT         7
      INTEGER TTOT,TDBTOT,TERR                                          COMT         8
      REAL TDIM,TDB2                                                    COMT         9
      CHARACTER * 3 TYPE,TDB1                                           COMT        10
*================================================                       COMT        11
* DESCRIPTION OF ARRAYS                                                 COMT        12
*================================================                       COMT        13
*   ID        MATERIAL    FRAME MATERIAL                                COMT        14
*------------------------------------------------                       COMT        15
*TYPE(X,1)   TYPE(X,2)   TYPE(X,3)                                     COMT        16
* A3          A3          A3                                            COMT        17
*================================================                       COMT        18
* HEIGHT      WIDTH       LAYER       DISTANCE                          COMT        19
*                         THICKNESS   ABOVE FLOOR                       COMT        20
*------------------------------------------------                       COMT        21
* TDIM(X,1)   TDIM(X,2)   TDIM(X,3)   TDIM(X,4)                         COMT        22
*  F8.2         F8.2        F8.2        F8.2                            COMT        23
*================================================                       COMT        24
*  ID       ATTENUATION    AREA                                         COMT        25
* ----------------------------------------------                        COMT        26
* TDB1(X)     TDB2(X,1)    TDB2(X,2)                                    COMT        27
*   A3          E9.3         E9.3                                       COMT        28
************************************************************************COMT        29
************************************************************************COMT        30
```

```
************************************************************************COMR       1
***    COMMON FOR ROOM ARRAY CONTAINING ATTENUATION OF WALLS         ***COMR       2
************************************************************************COMR       3
      INTEGER RMAX                                                      COMR       4
      PARAMETER (RMAX = 20)                                             COMR       5
      COMMON /ROOMN/ ROOM(RMAX + 6, RMAX + 6), NROOMS, RAREA(RMAX)      COMR       6
      INTEGER NROOMS                                                    COMR       7
      REAL ROOM                                                         COMR       8
************************************************************************COMR       9
************************************************************************COMR      10
************************************************************************COMW       1
***    COMMON FOR DATABASE OF WALL PARAMETERS                        ***COMW       2
************************************************************************COMW       3
      INTEGER WMAX                                                      COMW       4
      PARAMETER (WMAX = 75)                                             COMW       5
      COMMON /WALLN/ WDIM(WMAX,3), WTOT, WERR                           COMW       6
      COMMON /WALLC/ WALL(WMAX,4)                                       COMW       7
      INTEGER WTOT,WERR                                                 COMW       8
      REAL WDIM                                                         COMW       9
      CHARACTER *3 WALL                                                 COMW      10
* ================================                                      COMW      11
** DESCRIPTION OF ARRAYS                                                COMW      12
* ================================                                      COMW      13
*    WALL IDENTIFICATION                                                COMW      14
* --------------------------------                                      COMW      15
* DIRECTION    FROM        TO                                           COMW      16
*              ROOM        ROOM                                         COMW      17
* --------------------------------                                      COMW      18
* WALL(X,1)    WALL(X,2)   WALL(X,3)                                    COMW      19
*  A3           A3          A3                                          COMW      20
* ======================================================                COMW      21
*       WALL PARAMETERS                                                 COMW      22
* ------------------------------------------------------                COMW      23
* MATERIAL    HEIGHT      WIDTH       LAYER THICKNESS                   COMW      24
* ------------------------------------------------------                COMW      25
* WALL(X,4)   WDIM(X,1)   WDIM(X,2)   WDIM(X,3)                         COMW      26
*  A3          F8.2        F8.2        F8.2                             COMW      27
************************************************************************COMW      28
************************************************************************COMW      29
************************************************************************COMD       1
*      COMMON FOR ABSORPTION AND REFLECTION COEFFICIENTS IN WALLS       COMD       2
************************************************************************COMD       3
      COMMON /ROOMD/DDABS(RMAX + 6, RMAX + 6 ) ,DREFL, DREFLW           COMD       4
      REAL DDABS ,DREFL , DREFLW                                        COMD       5
************************************************************************COMD       6
************************************************************************COMD       7
      INTEGER NEXT, LAST, R, ROW                                        DFACTOR    8
      REAL AFACTOR,DREFLT                                               DFACTOR    9
      REAL WATTEN,LATTEN,OATTEN,MATTEN,ATTEN,T,S,TS,TS2                 DFACTOR   10
      REAL HEIGHT,WIDTH,AREA,OAREA,WAREA                                DFACTOR   11
      CHARACTER * 3 FROM, TO, MAT, ID                                   DFACTOR   12
      LOGICAL NEWWALL,WALLEND                                           DFACTOR   13
***                                                                     DFACTOR   14
*** THIS ROUTINE CALCULATES THE ABSORPTION OF THE WALL AND EACH         DFACTOR   15
*** OPENING IN THE WALL, LAYER BY LAYER, AND THEN CALCULATES THE        DFACTOR   16
*** COMPOSITE ABSORPTION BY WEIGHTING BY AREA EACH OPENING'S ABSORPTION DFACTOR   17
*** AND THE WALL ABSORPTION.                                            DFACTOR   18
*** FOR REFLECTIONS, THE ABSORPTION IS DECREASED BY "DREFL" IF          DFACTOR   19
*** THE WALL HAS A REFLECTION COEFFICIENT GREATER THAN 0.80 AND         DFACTOR   20
*** THE ROOM HAS A RESONANCE.                                           DFACTOR   21
***                                                                     DFACTOR   22
*** VARIABLE DEFINITIONS:                                               DFACTOR   23
***    DREFLT: EQUALS DREFL IF RESONANCE, OTHERWISE ZERO                DFACTOR   24
***                 IT REPRESENTS REFLECTION GAINS                      DFACTOR   25
```

```
***   WATTEN: WALL ATTENUATION                                                   DFACTOR    26
***   OATTEN: OPENING ATTENUATION                                                DFACTOR    27
***   LATTEN: LAYER ATTENUATION                                                  DFACTOR    28
***   MATTEN: MATERIAL ATTENUATION                                               DFACTOR    29
***   MAT: MATERIAL IDENTIFICATION                                               DFACTOR    30
***   WALL: WALL ARRAY CONTAINING WALL IDENTIFICATION AND MATERIAL               DFACTOR    31
***   WDIM: WALL ARRAY CONTAINING PHYSICAL DIMENSIONS OF THE WALL                DFACTOR    32
***   WMAX: MAXIMUM SIZE OF WALL AND WDIM ARRAYS                                 DFACTOR    33
***   WTOT: TOTAL LINES OF DATA IN THE THE WALL AND WDIM ARRAYS.                 DFACTOR    34
***   HEIGHT: HEIGHT OF WALL                                                     DFACTOR    35
***   WIDTH: WIDTH OF WALL                                                       DFACTOR    36
***   T:      THICKNESS OF WALL                                                  DFACTOR    37
***   AREA: AREA                                                                 DFACTOR    38
***   WAREA: TOTAL WALL AREA WITHOUT SUBTRACTING OPENINGS.                       DFACTOR    39
***   OAREA: TOTAL AREA OF THE OPENINGS.                                         DFACTOR    40
***   NEWWALL: TRUE IF DATA LINE BELONGS TO A NEW WALL                           DFACTOR    41
***   WALLEND: TRUE IF DATA LINE IS THE LAST DATA LINE OF A WALL                 DFACTOR    42
***                                                                              DFACTOR    43
      DO 10 R = 1,WTOT                                                           DFACTOR    44
***                                                                              DFACTOR    45
*** SET WALLEND CONDITION                                                        DFACTOR    46
      NEXT = R + 1                                                               DFACTOR    47
      IF (R .EQ. WTOT) THEN                                                      DFACTOR    48
         WALLEND = .TRUE.                                                        DFACTOR    49
      ELSE IF ( WALL(R,2) .NE. WALL(NEXT,2) .OR.                                 DFACTOR    50
     Z          WALL(R,3) .NE. WALL(NEXT,3) ) THEN                               DFACTOR    51
         WALLEND = .TRUE.                                                        DFACTOR    52
      ELSE                                                                       DFACTOR    53
         WALLEND = .FALSE.                                                       DFACTOR    54
         END IF                                                                  DFACTOR    55
***                                                                              DFACTOR    56
*** SET NEWWALL CONDITION                                                        DFACTOR    57
      LAST = R - 1                                                               DFACTOR    58
      IF (R .EQ. 1) THEN                                                         DFACTOR    59
         NEWWALL = .TRUE.                                                        DFACTOR    60
      ELSE IF ( WALL(R,2) .NE. WALL(LAST,2) .OR.                                 DFACTOR    61
     Z          WALL(R,3) .NE. WALL(LAST,3) ) THEN                               DFACTOR    62
         NEWWALL = .TRUE.                                                        DFACTOR    63
      ELSE                                                                       DFACTOR    64
         NEWWALL = .FALSE.                                                       DFACTOR    65
         END IF                                                                  DFACTOR    66
***                                                                              DFACTOR    67
*** CALCULATE                                                                    DFACTOR    68
      IF (NEWWALL) THEN                                                          DFACTOR    69
C*       ..INITIALIZE WALL CONDITIONS                                            DFACTOR    70
      DREFLT = 0.0                                                               DFACTOR    71
         TS = 0                                                                  DFACTOR    72
         TS2 = 0                                                                 DFACTOR    73
         WATTEN = 0                                                              DFACTOR    74
         END IF                                                                  DFACTOR    75
***   ..CALCULATE ATTENUATION FACTOR OF LAYER                                    DFACTOR    76
      MAT = WALL(R,4)                                                            DFACTOR    77
      MATTEN = ATTEN (MAT,FREQ,AFLAG)                                            DFACTOR    78
      CALL RESONW (WALL(R,2) , MAT)                                              DFACTOR    79
      IF(DREFL.GT.0.0) DREFLT = DREFL                                            DFACTOR    80
      LATTEN = MATTEN * WDIM(R,3)                                                DFACTOR    81
***   ..CALCULATE RUNNING AFACTOR OF WALL                                        DFACTOR    82
      WATTEN = WATTEN + LATTEN                                                   DFACTOR    83
      IF (WALLEND) THEN                                                          DFACTOR    84
         FROM = WALL(R,2)                                                        DFACTOR    85
         TO = WALL(R,3)                                                          DFACTOR    86
***   ...CALCULATE WEIGHTED AFACTOR OF OPENINGS                                  DFACTOR    87
***   ...AND TOTAL AREA OF OPENINGS                                              DFACTOR    88
         OAREA = 0                                                               DFACTOR    89
```

```
            DO 20 ROW = 1, HTOT
            IF (HOLE(ROW,2) .EQ. FROM .AND. HOLE(ROW,3) .EQ. TO) THEN
               ID = HOLE(ROW,4)
               CALL SRCHTDB(ID, OATTEN,AREA)
               OAREA = OAREA + AREA
               IF (OATTEN .LE. 120) THEN
                  T = 1.0 - 10**(-OATTEN / 10 )
               ELSE
                  T = 1.0
               ENDIF
               S = AREA
               TS = TS + T * S
               TS2 = TS2 + T * S * S
               END IF
 20         CONTINUE
***      ...CALCULATE TOTAL WALL AREA
            HEIGHT = WDIM(R,1)
            WIDTH = WDIM(R,2)
            WAREA = HEIGHT * WIDTH
            S = WAREA - OAREA
            IF (WATTEN .LE. 120.) THEN
               T = 1.0 - 10**(-WATTEN / 10) -DREFLT
            ELSE
               T = 1.0  - DREFLT
            ENDIF
            IF(T.LT.0.0) T=0.0
***      ...CALCULATE COMPOSITE ATTENUATION FACTOR OF WALL
            TS = TS + T * S
            TS2 = TS2 + T * S * S
***      ...INSERT COMPOSITE ATTENUATION OF WALL INTO ROOM MATRIX
            CALL LDDABS (TS,TS2,FROM,TO)
            END IF
 10      CONTINUE
         RETURN
         END
```

--VARIABLE MAP--(LO=A)

```
-NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

 AFACTOR  NONE                UNUSED/*S*       REAL
 AFLAG       2B  /INITILN/                     REAL
 AREA      446B                                REAL
 BLDG        0B  /INITILC/                     CHAR*5
 DDABS       0B  /ROOMD/                       REAL          676
 DREFL    1244B  /ROOMD/                       REAL
 DREFLT    433B                                REAL
 DREFLW   1245B  /ROOMD/                       REAL
 FERR       66B  /INITILN/                     INTEGER
 FREQ        0B  /INITILN/                     REAL
 FREQA       4B  /INITILN/                     REAL           50
 FROM      451B                                CHAR*3
 FTOT       67B  /INITILN/                     INTEGER
 HEIGHT    444B                                REAL
 HERR        1B  /HOLEN/                       INTEGER
 HOLE        0B  /HOLEC/                       CHAR*3        140
 HTOT        0B  /HOLEN/                       INTEGER
 ID        454B                                CHAR*3
 LAST      430B                                INTEGER
 LATTEN    435B                                REAL
 MAT       453B                                CHAR*3
 MATTEN    437B                                REAL
 NEWWALL   455B                                LOGICAL
 NEXT      427B                                INTEGER
```

```
 NROOMS    1244B  /ROOMN/                     INTEGER
 OAREA      447B                              REAL
 OATTEN     436B                              REAL
 QUALITY      1B  /INITILN/                   INTEGER
 R          431B                              INTEGER
 RAREA     1245B  /ROOMN/                     REAL           20
 RFLAG        3B  /INITILN/                   REAL
 ROOM         0B  /ROOMN/                     REAL          676
 ROW        432B                              INTEGER
 S          441B                              REAL
 T          440B                              REAL
 TDBTOT     323B  /TYPEN/                     INTEGER
 TDB1        37B  /TYPEC/                     CHAR*3         35
 TDB2       215B  /TYPEN/                     REAL           70
 TDIM         0B  /TYPEN/                     REAL          140
 TERR       324B  /TYPEN/                     INTEGER
 TO         452B                              CHAR*3
 TS         442B                              REAL
 TS2        443B                              REAL
 TTOT       214B  /TYPEN/                     INTEGER
 TYPE         0B  /TYPEC/                     CHAR*3        105
 WALL         0B  /WALLC/                     CHAR*3        300
 WALLEND    456B                              LOGICAL
 WAREA      450B                              REAL
 WATTEN     434B                              REAL
 WDIM         0B  /WALLN/                     REAL          225
 WERR       342B  /WALLN/                     INTEGER
 WIDTH      445B                              REAL
 WTOT       341B  /WALLN/                     INTEGER


--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE------------------------VALUE

 FMAX     INTEGER                        50
 HMAX     INTEGER                        35
 RMAX     INTEGER                        20
 TMAX     INTEGER                        35
 WMAX     INTEGER                        75


--PROCEDURES--(LO=A)
 -NAME------TYPE--------ARGS------CLASS-----

 ATTEN      REAL           3      FUNCTION
 LDDABS                    4      SUBROUTINE
 RESONW                    2      SUBROUTINE
 SRCHTDB                   3      SUBROUTINE


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

    10  INACTIVE   DO-TERM       225
    20  INACTIVE   DO-TERM       207
```

```
--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  DFACTOR      5B      0


--STATISTICS--

  PROGRAM-UNIT LENGTH              463B =   307
  CM LABELLED COMMON LENGTH       4000B =  2048
  CM STORAGE USED                63000B = 26112
  COMPILE TIME                  0.230 SECONDS
```

```
      SUBROUTINE LDDABS ( TS, TS2, FROM, TO )                          LDDABS        1
*****************************************************************************LDDABS        2
*   THIS ROUTINE LOADS THE ABSORPTION COEFFICIENT INTO THE APPROPRIATE  LDDABS        3
*   LOCATION IN THE 'DDABS' ARRAY.                                     LDDABS        4
*                                                                      LDDABS        5
*   NROOMS: TOTAL NUMBERS OF ROOMS REPRESENTED BY DATA                 LDDABS        6
*   RMAX: MAXIMUM NUMBER POSSIBLE UNDER THE PRESENT PROGRAM CONFIGURATIOLDDABS        7
*   TS AND TS2: ABSORPTION COEFFICIENTS                                LDDABS        8
*   FROM: TO: CONTAINS ROOM#'S OR THE DIRECTIONS D1,D2,4,D5,OR D6.     LDDABS        9
*****************************************************************************LDDABS       10
*****************************************************************************COMR          1
***   COMMON FOR ROOM ARRAY CONTAINING ATTENUATION OF WALLS          ***COMR          2
*****************************************************************************COMR          3
      INTEGER RMAX                                                     COMR          4
      PARAMETER (RMAX = 20)                                            COMR          5
      COMMON /ROOMN/ ROOM(RMAX + 6, RMAX + 6), NROOMS, RAREA(RMAX)     COMR          6
      INTEGER NROOMS                                                   COMR          7
      REAL ROOM                                                        COMR          8
*****************************************************************************COMR          9
*****************************************************************************COMR         10
*****************************************************************************COMD          1
*     COMMON FOR ABSORPTION AND REFLECTION COEFFICIENTS IN WALLS       COMD          2
*****************************************************************************COMD          3
      COMMON /ROOMD/DDABS(RMAX + 6, RMAX + 6 ) ,DREFL, DREFLW          COMD          4
      REAL DDABS ,DREFL , DREFLW                                       COMD          5
*****************************************************************************COMD          6
*****************************************************************************COMD          7
      INTEGER VAL, C, R, RNUM, D                                       LDDABS       13
      REAL TS, TS2                                                     LDDABS       14
      CHARACTER * 3 FROM, TO                                           LDDABS       15
*****************************************************************************LDDABS       16
      IF ( FROM(1:1) .EQ. 'D' ) THEN                                   LDDABS       17
         RNUM = VAL ( TO(1:2) )                                        LDDABS       18
         D = VAL ( FROM(2:2) )                                         LDDABS       19
*****************************************************************************LDDABS       20
*   INSERT ABSORPTION COEFFICENT FOR ENERGY ENTERING A ROOM FROM THE   LDDABS       21
*   OUTSIDE OF THE BUILDING.                                           LDDABS       22
*****************************************************************************LDDABS       23
         R = NROOMS + D                                                LDDABS       24
         C = RNUM                                                      LDDABS       25
         DDABS(R,C) = TS  + DDABS(R,C)                                 LDDABS       26
*****************************************************************************LDDABS       27
*   INSERT ABSORPTION COEFFICIENT INTO 'DDABS' ARRAY FOR ENERGY LEAVING LDDABS       28
*   A ROOM TO THE OUTSIDE OF THE BUILDING.                             LDDABS       29
*****************************************************************************LDDABS       30
         R = RNUM                                                      LDDABS       31
         C = NROOMS + D                                                LDDABS       32
         DDABS(R,C) = TS2 / RAREA(RNUM) + DDABS(R,C)                   LDDABS       33
*****************************************************************************LDDABS       34
      ELSE IF ( TO(1:1) .EQ. 'D' ) THEN                                LDDABS       35
         RNUM = VAL ( FROM(1:2) )                                      LDDABS       36
         D = VAL ( TO(2:2) )                                           LDDABS       37
*****************************************************************************LDDABS       38
*   INSERT ABSORPTION COEFFICIENT INTO 'DDABS' ARRAY FOR ENERGY ENTERINGLDDABS       39
*   A ROOM FROM THE OUTSIDE OF THE BUILDING.                           LDDABS       40
*****************************************************************************LDDABS       41
         R = NROOMS + D                                                LDDABS       42
         C = RNUM                                                      LDDABS       43
         DDABS(R,C) = TS  + DDABS(R,C)                                 LDDABS       44
*****************************************************************************LDDABS       45
*   INSERT ABSORPTION COEFFICIENT INTO 'DDABS' ARRAY FOR ENERGY LEAVING LDDABS       46
*   A ROOM TO THE OUTSIDE OF THE BUILDING.                             LDDABS       47
*****************************************************************************LDDABS       48
         R = RNUM                                                      LDDABS       49
```

```
           C = NROOMS + D                                                LDDABS   50
           DDABS(R,C) = TS2 / RAREA(RNUM) + DDABS(R,C)                   LDDABS   51
************************************************************************LDDABS   52
        ELSE                                                             LDDABS   53
************************************************************************LDDABS   54
*   INSERT ABSORPTION COEFFICIENTS INTO 'DDABS' ARRAY FOR ENERGY GOING   LDDABS   55
*   FROM ROOM TO ROOM.                                                   LDDABS   56
************************************************************************LDDABS   57
           R = VAL ( FROM(1:2) )                                         LDDABS   58
           C = VAL ( TO(1:2) )                                           LDDABS   59
           DDABS(R,C) = TS2 / RAREA(R)  + DDABS(R,C)                     LDDABS   60
           DDABS(C,R) = TS2 / RAREA(C)  + DDABS(C,R)                     LDDABS   61
        ENDIF                                                            LDDABS   62
        RETURN                                                           LDDABS   63
        END                                                              LDDABS   64
```

```
--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  C          222B                             INTEGER
  D          225B                             INTEGER
  DDABS        0B  /ROOMD/                    REAL          676
  DREFL     1244B  /ROOMD/                    REAL
  DREFLW    1245B  /ROOMD/                    REAL
  FROM         3   DUMMY-ARG                  CHAR*3
  NROOMS    1244B  /ROOMN/                    INTEGER
  R          223B                             INTEGER
  RAREA     1245B  /ROOMN/                    REAL           20
  RNUM       224B                             INTEGER
  ROOM         0B  /ROOMN/                    REAL          676
  TO           4   DUMMY-ARG                  CHAR*3
  TS           1   DUMMY-ARG                  REAL
  TS2          2   DUMMY-ARG                  REAL


--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE------------------------VALUE

  RMAX    INTEGER                        20


--PROCEDURES--(LO=A)
 -NAME------TYPE--------ARGS------CLASS-----

  VAL       INTEGER         1      FUNCTION


--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  LDDABS      5B     4


--STATISTICS--

  PROGRAM-UNIT LENGTH            230B =   152
  CM LABELLED COMMON LENGTH     2537B =  1375
  CM STORAGE USED              61000B = 25088
  COMPILE TIME                 0.103 SECONDS
```

```
      SUBROUTINE PDDABS                                                 PDDABS     1
C** PRINTOUT THE CONTENTS OF THE ROOM MATRIX                            PDDABS     2
************************************************************************COMF       1
*** COMMON FOR INITIAL PARAMETERS                                    ***COMF       2
************************************************************************COMF       3
      INTEGER FMAX                                                      COMF       4
      PARAMETER (FMAX = 50)                                             COMF       5
      COMMON /INITILN/ FREQ, QUALITY, AFLAG, RFLAG, FREQA(FMAX), FERR,  COMF       6
     $                 FTOT                                             COMF       7
      COMMON /INITILC/ BLDG                                             COMF       8
      CHARACTER * 5 BLDG                                                COMF       9
      REAL FREQ, AFLAG, RFLAG, FREQA                                    COMF      10
      INTEGER QUALITY, FERR, FTOT                                       COMF      11
************************************************************************COMF      12
************************************************************************COMF      13
************************************************************************COMR       1
***   COMMON FOR ROOM ARRAY CONTAINING ATTENUATION OF WALLS          ***COMR       2
************************************************************************COMR       3
      INTEGER RMAX                                                      COMR       4
      PARAMETER (RMAX = 20)                                             COMR       5
      COMMON /ROOMN/ ROOM(RMAX + 6, RMAX + 6), NROOMS, RAREA(RMAX)      COMR       6
      INTEGER NROOMS                                                    COMR       7
      REAL ROOM                                                         COMR       8
************************************************************************COMR       9
************************************************************************COMR      10
*****************************************************************       COMJ       1
*                                                                       COMJ       2
* COMMON FOR EVALUATION OF ROOM MATRIX                                  COMJ       3
*                                                                       COMJ       4
*****************************************************************       COMJ       5
      COMMON /MAT/TMAT(RMAX,RMAX),ENERGY(RMAX),POWER(6),FTIME           COMJ       6
     +,SWR(RMAX,6),IDIR                                                 COMJ       7
      REAL TMAT ,ENERGY,POWER,SWR                                       COMJ       8
      LOGICAL FTIME                                                     COMJ       9
************************************************************************COMD       1
*     COMMON FOR ABSORPTION AND REFLECTION COEFFICIENTS IN WALLS        COMD       2
************************************************************************COMD       3
      COMMON /ROOMD/DDABS(RMAX + 6, RMAX + 6 ) ,DREFL, DREFLW           COMD       4
      REAL DDABS ,DREFL , DREFLW                                        COMD       5
************************************************************************COMD       6
************************************************************************COMD       7
      INTEGER R,C                                                       PDDABS     7
      PRINT*                                                            PDDABS     8
      PRINT*,'     DDABS MATRIX VALUES '                                PDDABS     9
      PRINT*,' AT FREQUENCY = ',FREQ,' HERTZ'                           PDDABS    10
      PRINT*,'  WITH AFLAG = ', AFLAG, ' PER CENT'                      PDDABS    11
      PRINT*,'**********************************************************PDDABS    12
     +*************'                                                    PDDABS    13
      DO 10 R = 1,NROOMS + 6                                            PDDABS    14
      PRINT 100,(DDABS(R,C), C = 1, NROOMS + 6 )                        PDDABS    15
   10 CONTINUE                                                          PDDABS    16
      PRINT*,'==========================================================PDDABS    17
     +============='                                                    PDDABS    18
  100 FORMAT(1X,12(F8.3) )                                              PDDABS    19
      RETURN                                                            PDDABS    20
      END                                                               PDDABS    21
```

```
SUBROUTINE PDDABS    74/175  OPT=0

--VARIABLE MAP--(LO=A)
-NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

 AFLAG        2B   /INITILN/                  REAL
 BLDG         0B   /INITILC/                  CHAR*5
 C          163B                              INTEGER
 DDABS        0B   /ROOMD/                    REAL            676
 DREFL     1244B   /ROOMD/                    REAL
 DREFLW    1245B   /ROOMD/                    REAL
 ENERGY     620B   /MAT/                      REAL             20
 FERR        66B   /INITILN/                  INTEGER
 FREQ         0B   /INITILN/                  REAL
 FREQA        4B   /INITILN/                  REAL             50
 FTIME      652B   /MAT/                      LOGICAL
 FTOT        67B   /INITILN/                  INTEGER
 IDIR      1043B   /MAT/                      INTEGER
 NROOMS    1244B   /ROOMN/                    INTEGER
 POWER      644B   /MAT/                      REAL              6
 QUALITY      1B   /INITILN/                  INTEGER
 R          162B                              INTEGER
 RAREA     1245B   /ROOMN/                    REAL             20
 RFLAG        3B   /INITILN/                  REAL
 ROOM         0B   /ROOMN/                    REAL            676
 SWR        653B   /MAT/                      REAL            120
 TMAT         0B   /MAT/                      REAL            400


--SYMBOLIC CONSTANTS--(LO=A)
-NAME----TYPE------------------------VALUE

 FMAX    INTEGER                        50
 RMAX    INTEGER                        20


--STATEMENT LABELS--(LO=A)
-LABEL-ADDRESS-----PROPERTIES----DEF

   10  INACTIVE   DO-TERM        51
  100    121B     FORMAT         54


--ENTRY POINTS--(LO=A)
-NAME---ADDRESS--ARGS---

 PDDABS      5B     0


--STATISTICS--

 PROGRAM-UNIT LENGTH           170B =  120
 CM LABELLED COMMON LENGTH    3674B =  1980
 CM STORAGE USED             61000B =  25088
 COMPILE TIME                0.071 SECONDS
```

SUBROUTINE IDDABS   74/175 OPT=0

```
     1        SUBROUTINE IDDABS                                                  IDDABS      1
     2 ***********************************************************************IDDABS      2
     3 *   INITIALIZE DDABS MATRIX.                                              IDDABS      3
     4 ***********************************************************************IDDABS      4
     5 ***********************************************************************COMR        1
     6 ***    COMMON FOR ROOM ARRAY CONTAINING ATTENUATION OF WALLS           ***COMR        2
     7 ***********************************************************************COMR        3
     8        INTEGER RMAX                                                      COMR        4
     9        PARAMETER (RMAX = 20)                                             COMR        5
    10        COMMON /ROOMN/ ROOM(RMAX + 6, RMAX + 6), NROOMS, RAREA(RMAX)      COMR        6
    11        INTEGER NROOMS                                                    COMR        7
    12        REAL ROOM                                                         COMR        8
    13 ***********************************************************************COMR        9
    14 ***********************************************************************COMR       10
    15 ***********************************************************************COMD        1
    16 *      COMMON FOR ABSORPTION AND REFLECTION COEFFICIENTS IN WALLS        COMD        2
    17 ***********************************************************************COMD        3
    18        COMMON /ROOMD/DDABS(RMAX + 6, RMAX + 6 ) ,DREFL, DREFLW           COMD        4
    19        REAL DDABS ,DREFL , DREFLW                                        COMD        5
    20 ***********************************************************************COMD        6
    21 ***********************************************************************COMD        7
    22        INTEGER R,C                                                       IDDABS      7
    23        DO 10 R = 1,RMAX                                                  IDDABS      8
    24        DO 10 C = 1,RMAX                                                  IDDABS      9
    25        DDABS(R,C) = 0.0                                                  IDDABS     10
    26     10 CONTINUE                                                          IDDABS     11
    27        DO 20 R = 1,RMAX                                                  IDDABS     12
    28        DO 20 C = RMAX + 1, RMAX + 5                                      IDDABS     13
    29        DDABS(R,C) = 0.0                                                  IDDABS     14
    30     20 CONTINUE                                                          IDDABS     15
    31        RETURN                                                            IDDABS     16
    32        END                                                               IDDABS     17
```

```
--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  C          70B                             INTEGER
  DDABS       0B  /ROOMD/                    REAL          676
  DREFL    1244B  /ROOMD/                    REAL
  DREFLW   1245B  /ROOMD/                    REAL
  NROOMS   1244B  /ROOMN/                    INTEGER
  R          67B                             INTEGER
  RAREA    1245B  /ROOMN/                    REAL           20
  ROOM        0B  /ROOMN/                    REAL          676


--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE------------------------VALUE

  RMAX    INTEGER                        20


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

     10  INACTIVE   DO-TERM        26
     20  INACTIVE   DO-TERM        30
```

```
SUBROUTINE IDDABS   74/175  OPT=0

--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  IDDABS      5B      0


--STATISTICS--

  PROGRAM-UNIT LENGTH              77B =  63
  CM LABELLED COMMON LENGTH     2537B =  1375
  CM STORAGE USED              61000B =  25088
  COMPILE TIME                 0.050 SECONDS
```

```
      SUBROUTINE PPWR2                                                  PPWR2          1
************************************************************************COMF           1
*** COMMON FOR INITIAL PARAMETERS                                    ***COMF           2
************************************************************************COMF           3
      INTEGER FMAX                                                      COMF           4
      PARAMETER (FMAX = 50)                                             COMF           5
      COMMON /INITILN/ FREQ, QUALITY, AFLAG, RFLAG, FREQA(FMAX), FERR,  COMF           6
     $                 FTOT                                             COMF           7
      COMMON /INITILC/ BLDG                                             COMF           8
      CHARACTER * 5 BLDG                                                COMF           9
      REAL FREQ, AFLAG, RFLAG, FREQA                                    COMF          10
      INTEGER QUALITY, FERR, FTOT                                       COMF          11
************************************************************************COMF          12
************************************************************************COMF          13
************************************************************************COMR           1
***   COMMON FOR ROOM ARRAY CONTAINING ATTENUATION OF WALLS          ***COMR           2
************************************************************************COMR           3
      INTEGER RMAX                                                      COMR           4
      PARAMETER (RMAX = 20)                                             COMR           5
      COMMON /ROOMN/ ROOM(RMAX + 6, RMAX + 6), NROOMS, RAREA(RMAX)      COMR           6
      INTEGER NROOMS                                                    COMR           7
      REAL ROOM                                                         COMR           8
************************************************************************COMR           9
************************************************************************COMR          10
*****************************************************************       COMJ           1
*                                                                       COMJ           2
* COMMON FOR EVALUATION OF ROOM MATRIX                                  COMJ           3
*                                                                       COMJ           4
*****************************************************************       COMJ           5
      COMMON /MAT/TMAT(RMAX,RMAX),ENERGY(RMAX),POWER(6),FTIME           COMJ           6
     +,SWR(RMAX,6),IDIR                                                 COMJ           7
      REAL TMAT ,ENERGY,POWER,SWR                                       COMJ           8
      LOGICAL FTIME                                                     COMJ           9
      REAL DB                                                           PPWR2          5
      WRITE(*,30) FREQ                                                  PPWR2          6
   30 FORMAT (//,"ATTENUATION AT A FREQUENCY OF",1PE10.3," HZ"          PPWR2          7
     +,/,"************************************************",            PPWR2          8
     +"****************************"                                    PPWR2          9
     +,/,"*        *                    DIRECTIONS   ",28X,"*",/,       PPWR2         10
     +"* ROOMS *      1            2            3           4  "  ,     PPWR2         11
     +"           5     *",/,"*******************************************" ,PPWR2   12
     +"*********************************")                              PPWR2         13
      WRITE(*,100) (IROW,(SWR(IROW,I),I=1,5), IROW=1,NROOMS)            PPWR2         14
  100 FORMAT ("* ",I3,3X,"*",F9.2,3X,F10.2,3X,F10.2,3X,F10.2,3X,F10.2,  PPWR2         15
     +"  *")                                                            PPWR2         16
      WRITE (*,120)                                                     PPWR2         17
  120 FORMAT ("************************************************" ,      PPWR2         18
     +"****************************")                                   PPWR2         19
      RETURN                                                            PPWR2         20
      END                                                               PPWR2         21
```

```
--VARIABLE MAP--(LO=A)
-NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

 AFLAG       2B  /INITILN/                   REAL
 BLDG        0B  /INITILC/                   CHAR*5
 DB        NONE             UNUSED/*S*       REAL
 ENERGY    620B  /MAT/                       REAL          20
 FERR       66B  /INITILN/                   INTEGER
 FREQ        0B  /INITILN/                   REAL
 FREQA       4B  /INITILN/                   REAL          50
 FTIME     652B  /MAT/                       LOGICAL
 FTOT       67B  /INITILN/                   INTEGER
```

```
 I           167B                                   INTEGER
 IDIR       1043B   /MAT/                           INTEGER
 IROW        165B                                   INTEGER
 NROOMS     1244B   /ROOMN/                         INTEGER
 POWER       644B   /MAT/                           REAL              6
 QUALITY       1B   /INITILN/                       INTEGER
 RAREA      1245B   /ROOMN/                         REAL             20
 RFLAG         3B   /INITILN/                       REAL
 ROOM          0B   /ROOMN/                         REAL            676
 SWR         653B   /MAT/                           REAL            120
 TMAT          0B   /MAT/                           REAL            400

--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE------------------------VALUE

 FMAX    INTEGER                         50
 RMAX    INTEGER                         20

--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

    30     56B     FORMAT          36
   100    123B     FORMAT          44
   120    133B     FORMAT          47

--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

 PPWR2      5B      0

--STATISTICS--

 PROGRAM-UNIT LENGTH              173B =  123
 CM LABELLED COMMON LENGTH       2426B =  1302
 CM STORAGE USED                61000B =  25088
 COMPILE TIME                   0.071 SECONDS
```

```
      SUBROUTINE SPWR                                                   SPWR     1
***********************************************************************COMF     1
*** COMMON FOR INITIAL PARAMETERS                                    ***COMF     2
***********************************************************************COMF     3
      INTEGER FMAX                                                      COMF     4
      PARAMETER (FMAX = 50)                                             COMF     5
      COMMON /INITILN/ FREQ, QUALITY, AFLAG, RFLAG, FREQA(FMAX), FERR,  COMF     6
     $                 FTOT                                             COMF     7
      COMMON /INITILC/ BLDG                                             COMF     8
      CHARACTER * 5 BLDG                                                COMF     9
      REAL FREQ, AFLAG, RFLAG, FREQA                                    COMF    10
      INTEGER QUALITY, FERR, FTOT                                       COMF    11
***********************************************************************COMF    12
***********************************************************************COMF    13
***********************************************************************COMR     1
***   COMMON FOR ROOM ARRAY CONTAINING ATTENUATION OF WALLS          ***COMR     2
***********************************************************************COMR     3
      INTEGER RMAX                                                      COMR     4
      PARAMETER (RMAX = 20)                                             COMR     5
      COMMON /ROOMN/ ROOM(RMAX + 6, RMAX + 6), NROOMS, RAREA(RMAX)      COMR     6
      INTEGER NROOMS                                                    COMR     7
      REAL ROOM                                                         COMR     8
***********************************************************************COMR     9
***********************************************************************COMR    10
****************************************************************        COMJ     1
*                                                                       COMJ     2
* COMMON FOR EVALUATION OF ROOM MATRIX                                  COMJ     3
*                                                                       COMJ     4
****************************************************************        COMJ     5
      COMMON /MAT/TMAT(RMAX,RMAX),ENERGY(RMAX),POWER(6),FTIME           COMJ     6
     +,SWR(RMAX,6),IDIR                                                 COMJ     7
      REAL TMAT ,ENERGY,POWER,SWR                                       COMJ     8
      LOGICAL FTIME                                                     COMJ     9
      REAL DB                                                           SPWR     5
      DO 100 IROW=1,NROOMS                                              SPWR     6
      IF(ENERGY(IROW).LT.1.0E-05) THEN                                  SPWR     7
      DB = -60.0                                                        SPWR     8
      GO TO 100                                                         SPWR     9
      ENDIF                                                             SPWR    10
        DB=10.0 * ALOG10 ( ENERGY( IROW) / 10. )                        SPWR    11
  100 SWR(IROW,IDIR)=DB                                                 SPWR    12
      RETURN                                                            SPWR    13
      END                                                               SPWR    14
```

```
--VARIABLE MAP--(LO=A)
-NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

 AFLAG       2B  /INITILN/                  REAL
 BLDG        0B  /INITILC/                  CHAR*5
 DB         55B                             REAL
 ENERGY    620B  /MAT/                      REAL            20
 FERR       66B  /INITILN/                  INTEGER
 FREQ        0B  /INITILN/                  REAL
 FREQA       4B  /INITILN/                  REAL            50
 FTIME     652B  /MAT/                      LOGICAL
 FTOT       67B  /INITILN/                  INTEGER
 IDIR     1043B  /MAT/                      INTEGER
 IROW       56B                             INTEGER
 NROOMS   1244B  /ROOMN/                    INTEGER
 POWER     644B  /MAT/                      REAL             6
 QUALITY     1B  /INITILN/                  INTEGER
 RAREA    1245B  /ROOMN/                    REAL            20
 RFLAG       3B  /INITILN/                  REAL
```

```
 ROOM        0B  /ROOMN/                    REAL         676
 SWR       653B  /MAT/                      REAL         120
 TMAT        0B  /MAT/                      REAL         400


--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE------------------------VALUE

  FMAX    INTEGER                        50
  RMAX    INTEGER                        20


--PROCEDURES--(LO=A)
 -NAME------TYPE--------ARGS------CLASS-----

  ALOG10    REAL          1       INTRINSIC


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

    100    31B     DO-TERM        41


--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  SPWR      5B     0


--STATISTICS--

  PROGRAM-UNIT LENGTH          62B =  50
  CM LABELLED COMMON LENGTH  2426B =  1302
  CM STORAGE USED           61000B =  25088
  COMPILE TIME              0.057 SECONDS
```

```
      SUBROUTINE RESONW(FROM,MATID)                                     RESONW     1
*                                                                       RESONW     2
*        THIS ROUTINE CHECKS FOR RESONANCE CONDITIONS IN A ROOM         RESONW     3
*        IF A RESONANCE IS POSSIBLE AT THE PARTICULAR FREQUENCY         RESONW     4
*        FOR THE ROOM AND THE WALL IN QUESTION HAS A REFLECTION         RESONW     5
*        COEFFICIENT GREATER THAN 0.80, THEN THE ABSORPTION FOR         RESONW     6
*        THE WALL IS REDUCED BY THE REFLECTION COEFFICIENT.             RESONW     7
*                                                                       RESONW     8
************************************************************************COMR       1
***   COMMON FOR ROOM ARRAY CONTAINING ATTENUATION OF WALLS          ***COMR       2
************************************************************************COMR       3
      INTEGER RMAX                                                      COMR       4
      PARAMETER (RMAX = 20)                                             COMR       5
      COMMON /ROOMN/ ROOM(RMAX + 6, RMAX + 6), NROOMS, RAREA(RMAX)      COMR       6
      INTEGER NROOMS                                                    COMR       7
      REAL ROOM                                                         COMR       8
************************************************************************COMR       9
************************************************************************COMR      10
************************************************************************COMW       1
***   COMMON FOR DATABASE OF WALL PARAMETERS                         ***COMW       2
************************************************************************COMW       3
      INTEGER WMAX                                                      COMW       4
      PARAMETER (WMAX = 75)                                             COMW       5
      COMMON /WALLN/ WDIM(WMAX,3), WTOT, WERR                           COMW       6
      COMMON /WALLC/ WALL(WMAX,4)                                       COMW       7
      INTEGER WTOT,WERR                                                 COMW       8
      REAL WDIM                                                         COMW       9
      CHARACTER *3 WALL                                                 COMW      10
* ================================                                      COMW      11
** DESCRIPTION OF ARRAYS                                                COMW      12
* ================================                                      COMW      13
*    WALL IDENTIFICATION                                                COMW      14
* --------------------------------                                      COMW      15
* DIRECTION    FROM        TO                                           COMW      16
*              ROOM        ROOM                                         COMW      17
* --------------------------------                                      COMW      18
* WALL(X,1)   WALL(X,2)   WALL(X,3)                                     COMW      19
*  A3          A3          A3                                           COMW      20
* ====================================================                  COMW      21
*        WALL PARAMETERS                                                COMW      22
* ----------------------------------------------------                  COMW      23
* MATERIAL    HEIGHT      WIDTH       LAYER THICKNESS                   COMW      24
* ----------------------------------------------------                  COMW      25
* WALL(X,4)   WDIM(X,1)   WDIM(X,2)   WDIM(X,3)                         COMW      26
*  A3          F8.2        F8.2        F8.2                             COMW      27
************************************************************************COMW      28
************************************************************************COMW      29
************************************************************************COMF       1
*** COMMON FOR INITIAL PARAMETERS                                    ***COMF       2
************************************************************************COMF       3
      INTEGER FMAX                                                      COMF       4
      PARAMETER (FMAX = 50)                                             COMF       5
      COMMON /INITILN/ FREQ, QUALITY, AFLAG, RFLAG, FREQA(FMAX), FERR,  COMF       6
     $                 FTOT                                             COMF       7
      COMMON /INITILC/ BLDG                                             COMF       8
      CHARACTER * 5 BLDG                                                COMF       9
      REAL FREQ, AFLAG, RFLAG, FREQA                                    COMF      10
      INTEGER QUALITY, FERR, FTOT                                       COMF      11
************************************************************************COMF      12
************************************************************************COMF      13
************************************************************************COMM       1
***   COMMON FOR DATABASE OF MATERIAL PROPERTIES                     ***COMM       2
************************************************************************COMM       3
      INTEGER MMAX                                                      COMM       4
```

```
      PARAMETER (MMAX=100)                                              COMM       5
      COMMON /MATN/ MATTEN(MMAX,7), MRCOEF(MMAX,7), QA(MMAX), QR(MMAX), COMM       6
     $               MFREQ(MMAX,7), MERR, MTOT                          COMM       7
      COMMON /MATC/MAT(MMAX),MATDESC(MMAX)                              COMM       8
      INTEGER MTOT, MERR                                                COMM       9
      REAL MATTEN, MRCOEF, MFREQ, QA, QR                                COMM      10
      CHARACTER * 3  MAT                                                COMM      11
      CHARACTER * 70 MATDESC                                            COMM      12
************************************************************************COMM      13
************************************************************************COMM      14
************************************************************************COMD       1
*     COMMON FOR ABSORPTION AND REFLECTION COEFFICIENTS IN WALLS        COMD       2
************************************************************************COMD       3
      COMMON /ROOMD/DDABS(RMAX + 6, RMAX + 6 ) ,DREFL, DREFLW           COMD       4
      REAL DDABS ,DREFL , DREFLW                                        COMD       5
************************************************************************COMD       6
************************************************************************COMD       7
      REAL A,B,C,RH,RL,RW                                               RESONW    14
      REAL MREFL                                                        RESONW    15
      CHARACTER * 3 FROM,MATID                                          RESONW    16
      ISET = 0                                                          RESONW    17
      MREFL = RCOEF (MATID,FREQ,RFLAG)                                  RESONW    18
      IF(MREFL.LT.0.80) THEN                                            RESONW    19
      DREFL = 0.0                                                       RESONW    20
      RETURN                                                            RESONW    21
      ENDIF                                                             RESONW    22
      IF(FROM(1:1) .EQ. 'D' ) THEN                                      RESONW    23
      DREFL = 0.0                                                       RESONW    24
      RETURN                                                            RESONW    25
      ENDIF                                                             RESONW    26
*                                                                       RESONW    27
*        NOW GET HEIGHT, WIDTH AND LENGTH OF ROOM                       RESONW    28
*                                                                       RESONW    29
      DO 100 I1 = 1, WTOT                                               RESONW    30
      IF( FROM.EQ.WALL(I1,2) .AND. WALL(I1,1).EQ.'FB ') THEN            RESONW    31
      RH = WDIM(I1,1)                                                   RESONW    32
      GOTO 200                                                          RESONW    33
      ENDIF                                                             RESONW    34
  100 CONTINUE                                                          RESONW    35
      DREFL = 0                                                         RESONW    36
      IWARN = 9                                                         RESONW    37
      CALL WARNING(IWARN)                                               RESONW    38
      RETURN                                                            RESONW    39
  200 I1 = 0                                                            RESONW    40
  300 I1 = I1 + 1                                                       RESONW    41
      IF(I1.GT.WTOT) THEN                                               RESONW    42
      DREFL = 0.0                                                       RESONW    43
      IF(ISET.EQ.1) RETURN                                              RESONW    44
      IWARN = 10                                                        RESONW    45
      CALL WARNING(IWARN)                                               RESONW    46
      RETURN                                                            RESONW    47
      ENDIF                                                             RESONW    48
      IF(FROM.EQ.WALL(I1,2) .AND. WALL(I1,1).EQ.'UD ') THEN             RESONW    49
      RL= WDIM(I1,2)                                                    RESONW    50
      RW= WDIM(I1,1)                                                    RESONW    51
      ELSE                                                              RESONW    52
      GOTO 300                                                          RESONW    53
      ENDIF                                                             RESONW    54
*                                                                       RESONW    55
*        NOW SORT OUT DIMENSIONS WITH A SMALLEST AND C LARGEST          RESONW    56
      ISET = 1                                                          RESONW    57
      IPASS = 0                                                         RESONW    58
      A = RH                                                            RESONW    59
      B = RW                                                            RESONW    60
```

```
          C = RL                                                      RESONW      61
     500  IF(A.GT.B) THEN                                             RESONW      62
          TMP= A                                                      RESONW      63
          A = B                                                       RESONW      64
          B = TMP                                                     RESONW      65
          IPASS = 0                                                   RESONW      66
          ELSE                                                        RESONW      67
          IPASS = 1                                                   RESONW      68
          ENDIF                                                       RESONW      69
          IF (B.GT.C) THEN                                            RESONW      70
          TMP =B                                                      RESONW      71
          B = C                                                       RESONW      72
          C = TMP                                                     RESONW      73
          IPASS = 0                                                   RESONW      74
          ENDIF                                                       RESONW      75
          IF (IPASS.EQ. 0) GOTO 500                                   RESONW      76
     *                                                                RESONW      77
     *       NOW CALCULATE LOWER RESONANCE FREQUENCY                  RESONW      78
          CLIGHT= 3.0E08                                              RESONW      79
          FLOW = 1.0/(B*B)  + 1.0/ (C*C)                              RESONW      80
          FLOW = SQRT(FLOW)                                           RESONW      81
          FLOW = FLOW*CLIGHT/2.0                                      RESONW      82
     *                                                                RESONW      83
     *       NOW CALCULATE HIGH FREQUENCY LIMIT                       RESONW      84
          FHIGH = 9.0*( 1.0/(A*A) + 1.0/(B*B) + 1.0/(C*C) )           RESONW      85
          FHIGH = SQRT (FHIGH)                                        RESONW      86
          FHIGH = FHIGH*CLIGHT/2.0                                    RESONW      87
          IF(FREQ.GE.FLOW .AND. FREQ.LE.FHIGH) THEN                   RESONW      88
          DREFL = MREFL                                               RESONW      89
          RETURN                                                      RESONW      90
          ELSE                                                        RESONW      91
          DREFL = 0.0                                                 RESONW      92
          GOTO 300                                                    RESONW      93
          ENDIF                                                       RESONW      94
          END                                                         RESONW      95
```

--VARIABLE MAP--(LO=A)

-NAME	---ADDRESS	--BLOCK	-----PROPERTIES	-------TYPE	---------SIZE
A	346B			REAL	
AFLAG	2B	/INITILN/		REAL	
B	347B			REAL	
BLDG	0B	/INITILC/		CHAR*5	
C	350B			REAL	
CLIGHT	363B			REAL	
DDABS	0B	/ROOMD/		REAL	676
DREFL	1244B	/ROOMD/		REAL	
DREFLW	1245B	/ROOMD/		REAL	
FERR	66B	/INITILN/		INTEGER	
FHIGH	365B			REAL	
FLOW	364B			REAL	
FREQ	0B	/INITILN/		REAL	
FREQA	4B	/INITILN/		REAL	50
FROM	1	DUMMY-ARG		CHAR*3	
FTOT	67B	/INITILN/		INTEGER	
IPASS	361B			INTEGER	
ISET	355B			INTEGER	
IWARN	360B			INTEGER	
I1	356B			INTEGER	
MAT	0B	/MATC/		CHAR*3	100
MATDESC	36B	/MATC/		CHAR*70	100
MATID	2	DUMMY-ARG		CHAR*3	
MATTEN	0B	/MATN/		REAL	700

```
 MERR      4374B  /MATN/                         INTEGER
 MFREQ     3100B  /MATN/                         REAL          700
 MRCOEF    1274B  /MATN/                         REAL          700
 MREFL      354B                                 REAL
 MTOT      4375B  /MATN/                         INTEGER
 NROOMS    1244B  /ROOMN/                        INTEGER
 QA        2570B  /MATN/                         REAL          100
 QR        2734B  /MATN/                         REAL          100
 QUALITY      1B  /INITILN/                      INTEGER
 RAREA     1245B  /ROOMN/                        REAL           20
 RFLAG        3B  /INITILN/                      REAL
 RH         351B                                 REAL
 RL         352B                                 REAL
 ROOM         0B  /ROOMN/                        REAL          676
 RW         353B                                 REAL
 TMP        362B                                 REAL
 WALL         0B  /WALLC/                        CHAR*3        300
 WDIM         0B  /WALLN/                        REAL          225
 WERR       342B  /WALLN/                        INTEGER
 WTOT       341B  /WALLN/                        INTEGER


--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE------------------------VALUE

 FMAX     INTEGER                          50
 MMAX     INTEGER                         100
 RMAX     INTEGER                          20
 WMAX     INTEGER                          75


--PROCEDURES--(LO=A)
 -NAME------TYPE--------ARGS------CLASS-----

 RCOEF      REAL            3       FUNCTION
 SQRT       GENERIC         1       INTRINSIC
 WARNING                    1       SUBROUTINE


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

    100  INACTIVE   DO-TERM       103
    200    102B                   108
    300    104B                   109
    500    162B                   130


--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

 RESONW       5B      2


--STATISTICS--

 PROGRAM-UNIT LENGTH             370B =   248
 CM LABELLED COMMON LENGTH     11255B =  4781
 CM STORAGE USED               61000B = 25088
 COMPILE TIME                  0.190 SECONDS
```

```
      SUBROUTINE RESOND(ID)                                             RESOND     1
*                                                                       RESOND     2
*                                                                       RESOND     3
*         THIS ROUTINE CALCULATES RESONANCES FOR DOORS AND              RESOND     4
*         WINDOWS.  IN THE RESONANCE FREQUENCY RANGE,  THE              RESOND     5
*         INPUT TRANSMISSION OF THE WINDOW OR DOOR IS  IN-              RESOND     6
*         BY 20 DB (ARBITRARY).                                         RESOND     7
*                                                                       RESOND     8
*                                                                       RESOND     9
************************************************************************COMR     1
***   COMMON FOR ROOM ARRAY CONTAINING ATTENUATION OF WALLS          ***COMR     2
************************************************************************COMR     3
      INTEGER RMAX                                                      COMR     4
      PARAMETER (RMAX = 20)                                             COMR     5
      COMMON /ROOMN/ ROOM(RMAX + 6, RMAX + 6), NROOMS, RAREA(RMAX)      COMR     6
      INTEGER NROOMS                                                    COMR     7
      REAL ROOM                                                         COMR     8
************************************************************************COMR     9
************************************************************************COMR    10
************************************************************************COMD     1
*     COMMON FOR ABSORPTION AND REFLECTION COEFFICIENTS IN WALLS        COMD     2
************************************************************************COMD     3
      COMMON /ROOMD/DDABS(RMAX + 6, RMAX + 6 ) ,DREFL, DREFLW           COMD     4
      REAL DDABS ,DREFL , DREFLW                                        COMD     5
************************************************************************COMD     6
************************************************************************COMD     7
************************************************************************COMF     1
*** COMMON FOR INITIAL PARAMETERS                                    ***COMF     2
************************************************************************COMF     3
      INTEGER FMAX                                                      COMF     4
      PARAMETER (FMAX = 50)                                             COMF     5
      COMMON /INITILN/ FREQ, QUALITY, AFLAG, RFLAG, FREQA(FMAX), FERR,  COMF     6
     $                 FTOT                                             COMF     7
      COMMON /INITILC/ BLDG                                             COMF     8
      CHARACTER * 5 BLDG                                                COMF     9
      REAL FREQ, AFLAG, RFLAG, FREQA                                    COMF    10
      INTEGER QUALITY, FERR, FTOT                                       COMF    11
************************************************************************COMF    12
************************************************************************COMF    13
************************************************************************COMT     1
***   COMMON FOR DATABASE OF TYPES OF DOORS AND WINDOWS              ***COMT     2
************************************************************************COMT     3
      INTEGER TMAX                                                      COMT     4
      PARAMETER (TMAX=35)                                               COMT     5
      COMMON /TYPEN/TDIM(TMAX,4),TTOT,TDB2(TMAX,2),TDBTOT,TERR          COMT     6
      COMMON /TYPEC/TYPE(TMAX,3),TDB1(TMAX)                             COMT     7
      INTEGER TTOT,TDBTOT,TERR                                          COMT     8
      REAL TDIM,TDB2                                                    COMT     9
      CHARACTER * 3 TYPE,TDB1                                           COMT    10
*=================================================                      COMT    11
* DESCRIPTION OF ARRAYS                                                 COMT    12
*=================================================                      COMT    13
*   ID        MATERIAL    FRAME MATERIAL                                COMT    14
*-------------------------------------------------                      COMT    15
*TYPE(X,1)   TYPE(X,2)   TYPE(X,3)                                      COMT    16
* A3         A3          A3                                             COMT    17
*=================================================                      COMT    18
* HEIGHT      WIDTH       LAYER        DISTANCE                         COMT    19
*                         THICKNESS    ABOVE FLOOR                      COMT    20
*-------------------------------------------------                      COMT    21
* TDIM(X,1)   TDIM(X,2)   TDIM(X,3)    TDIM(X,4)                        COMT    22
*  F8.2        F8.2        F8.2         F8.2                            COMT    23
*=================================================                      COMT    24
*  ID       ATTENUATION    AREA                                         COMT    25
```

```
* ---------------------------------------------                        COMT      26
* TDB1(X)     TDB2(X,1)     TDB2(X,2)                                  COMT      27
*   A3           E9.3          E9.3                                    COMT      28
***********************************************************************COMT      29
***********************************************************************COMT      30
      CHARACTER * 3, ID, MATID                                         RESOND    14
      DO 10 I = 1, TTOT                                                RESOND    15
      J=I                                                              RESOND    16
      IF(TYPE(I,1) .EQ. ID) GOTO 20                                    RESOND    17
   10 CONTINUE                                                         RESOND    18
      IWARN = 11                                                       RESOND    19
      CALL WARNING(IWARN)                                              RESOND    20
      DREFLW = 0.0                                                     RESOND    21
      RETURN                                                           RESOND    22
   20 CONTINUE                                                         RESOND    23
      MATID = TYPE (J,3)                                               RESOND    24
      RH = TDIM (J,1)                                                  RESOND    25
      RW = TDIM (J,2)                                                  RESOND    26
      REFL = RCOEF( MATID, FREQ, RFLAG)                                RESOND    27
      IF( REFL .LT. 0.80 ) THEN                                        RESOND    28
      DREFLW = 0.0                                                     RESOND    29
      RETURN                                                           RESOND    30
      ENDIF                                                            RESOND    31
      A = RH                                                           RESOND    32
      B = RW                                                           RESOND    33
      IF( A.GT.B) THEN                                                 RESOND    34
      TMP = B                                                          RESOND    35
      B = A                                                            RESOND    36
      A = TMP                                                          RESOND    37
      ENDIF                                                            RESOND    38
      FLOW =  3.0E8 / 2/ B                                             RESOND    39
      FHIGH = 3.0E8 / 2.0 * 3.0 * SQRT( 1/(B*B) + 1 / (A*A) )          RESOND    40
      IF(FREQ.GE.FLOW .AND. FREQ.LE.FHIGH) THEN                        RESOND    41
      DREFLW = 20.0                                                    RESOND    42
      ELSE                                                             RESOND    43
      DREFLW = 0.0                                                     RESOND    44
      ENDIF                                                            RESOND    45
      RETURN                                                           RESOND    46
      END                                                              RESOND    47
```

```
--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  A          205B                              REAL
  AFLAG        2B  /INITILN/                   REAL
  B          206B                              REAL
  BLDG         0B  /INITILC/                   CHAR*5
  DDABS        0B  /ROOMD/                     REAL            676
  DREFL     1244B  /ROOMD/                     REAL
  DREFLW    1245B  /ROOMD/                     REAL
  FERR        66B  /INITILN/                   INTEGER
  FHIGH      211B                              REAL
  FLOW       210B                              REAL
  FREQ         0B  /INITILN/                   REAL
  FREQA        4B  /INITILN/                   REAL             50
  FTOT        67B  /INITILN/                   INTEGER
  I          176B                              INTEGER
  ID           1   DUMMY-ARG                   CHAR*3
  IWARN      201B                              INTEGER
  J          200B                              INTEGER
  MATID      175B                              CHAR*3
  NROOMS    1244B  /ROOMN/                     INTEGER
  QUALITY      1B  /INITILN/                   INTEGER
```

```
 RAREA     1245B  /ROOMN/                         REAL          20
 REFL       204B                                  REAL
 RFLAG        3B  /INITILN/                       REAL
 RH         202B                                  REAL
 ROOM         0B  /ROOMN/                         REAL         676
 RW         203B                                  REAL
 TDBTOT     323B  /TYPEN/                         INTEGER
 TDB1        37B  /TYPEC/                         CHAR*3        35
 TDB2       215B  /TYPEN/                         REAL          70
 TDIM         0B  /TYPEN/                         REAL         140
 TERR       324B  /TYPEN/                         INTEGER
 TMP        207B                                  REAL
 TTOT       214B  /TYPEN/                         INTEGER
 TYPE         0B  /TYPEC/                         CHAR*3       105


--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE------------------------VALUE

 FMAX     INTEGER                        50
 RMAX     INTEGER                        20
 TMAX     INTEGER                        35


--PROCEDURES--(LO=A)
 -NAME------TYPE---------ARGS------CLASS-----

 RCOEF      REAL            3      FUNCTION
 SQRT       GENERIC         1      INTRINSIC
 WARNING                    1      SUBROUTINE


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

    10  INACTIVE   DO-TERM        74
    20     43B                    79


--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

 RESOND      5B     1


--STATISTICS--

 PROGRAM-UNIT LENGTH              214B =  140
 CM LABELLED COMMON LENGTH       3227B =  1687
 CM STORAGE USED                61000B =  25088
 COMPILE TIME                    0.120 SECONDS
```

```
      SUBROUTINE LFREQ                                                  LFREQ      1
*[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[LFREQ      2
*[[[                                                                [[[LFREQ      3
*[[[   LOAD THE CONTENTS OF THE FILE 'BXXXXXF' INTO ARRAYS FREQA.       LFREQ      4
*[[[                                                                [[[LFREQ      5
*[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[[LFREQ      6
************************************************************************LFREQ      7
************************************************************************COMF       1
*** COMMON FOR INITIAL PARAMETERS                                    ***COMF       2
************************************************************************COMF       3
      INTEGER FMAX                                                      COMF       4
      PARAMETER (FMAX = 50)                                             COMF       5
      COMMON /INITILN/ FREQ, QUALITY, AFLAG, RFLAG, FREQA(FMAX), FERR,  COMF       6
     $                 FTOT                                             COMF       7
      COMMON /INITILC/ BLDG                                             COMF       8
      CHARACTER * 5 BLDG                                                COMF       9
      REAL FREQ, AFLAG, RFLAG, FREQA                                    COMF      10
      INTEGER QUALITY, FERR, FTOT                                       COMF      11
************************************************************************COMF      12
************************************************************************COMF      13
**************************************************                      LFREQ      9
*   DECLARATION OF VARIABLES                                            LFREQ     10
**************************************************                      LFREQ     11
      INTEGER GETLEN, R, C                                              LFREQ     12
      CHARACTER * 7 NAME, PFN                                           LFREQ     13
**************************************************                      LFREQ     14
*                                                                       LFREQ     15
**************************************************                      LFREQ     16
      NAME = 'B'//BLDG(1:GETLEN(BLDG))//'F'                             LFREQ     17
      PFN = NAME (1:GETLEN(NAME))                                       LFREQ     18
      FERR = 0                  :G                                      LFREQ     19
      CALL PF ('GET',0,PFN(1ETLEN(PFN)),'RC',FERR)                    LFREQ     20
      IF ( FERR .EQ. 0 ) THEN                                           LFREQ     21
        OPEN (UNIT=3, FILE=PFN, FORM='FORMATTED',                       LFREQ     22
     $        STATUS='OLD', ACCESS='SEQUENTIAL')                        LFREQ     23
        FTOT = 0                                                        LFREQ     24
        DO 10 R = 1,FMAX                                                LFREQ     25
          READ (3,1000,END=20) FREQA(R)                                 LFREQ     26
 1000     FORMAT(E12.7)                                                 LFREQ     27
          FTOT = FTOT + 1                                               LFREQ     28
 10     CONTINUE                                                        LFREQ     29
 20     CONTINUE                                                        LFREQ     30
        CLOSE(3,STATUS='DELETE')                                        LFREQ     31
      ELSE IF ( FERR .EQ. 2 ) THEN                                      LFREQ     32
        CALL WARNING (11)                                               LFREQ     33
      ELSE                                                              LFREQ     34
        CALL WARNING (12)                                               LFREQ     35
      END IF                                                            LFREQ     36
      RETURN                                                            LFREQ     37
      END                                                               LFREQ     38
```

```
--VARIABLE MAP--(LO=A)
 -NAME---ADDRESS--BLOCK-----PROPERTIES-------TYPE---------SIZE

  AFLAG       2B  /INITILN/                  REAL
  BLDG        0B  /INITILC/                  CHAR*5
  C         NONE            UNUSED/*S*       INTEGER
  FERR       66B  /INITILN/                  INTEGER
  FREQ        0B  /INITILN/                  REAL
  FREQA       4B  /INITILN/                  REAL            50
  FTOT       67B  /INITILN/                  INTEGER
  NAME      210B                             CHAR*7
  PFN       211B                             CHAR*7
```

```
 QUALITY      1B   /INITILN/                       INTEGER
 R          207B                                   INTEGER
 RFLAG        3B   /INITILN/                       REAL


--SYMBOLIC CONSTANTS--(LO=A)
 -NAME----TYPE------------------------VALUE

 FMAX     INTEGER                          50


--PROCEDURES--(LO=A)
 -NAME------TYPE--------ARGS------CLASS-----

 GETLEN     INTEGER         1       FUNCTION
 PF                         5       SUBROUTINE
 WARNING                    1       SUBROUTINE


--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF

     10  INACTIVE   DO-TERM        41
     20      63B                   42
   1000     120B     FORMAT        39


--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

 LFREQ       5B      0


--I/O UNITS--(LO=A)
 -NAME--- PROPERTIES-------------

 TAPE3   AUX/FMT/SEQ


--STATISTICS--

 PROGRAM-UNIT LENGTH              215B =  141
 CM LABELLED COMMON LENGTH         71B =  57
 CM STORAGE USED                61000B =  25088
 COMPILE TIME                   0.085 SECONDS
```

Appendix 9.8 Blank Forms for Data Taking.

WALLS DATA FORM

BUILDING I. D. NUMBER____________________ DATE____________________

NAME______________________________

LINE #	DIRECTION	FROM	TO	HEIGHT(m)	WIDTH(m)	THICKNESS(cm)	MATERIAL	COMMENT

HOLES DATA FORM

BUILDING I.D. NUMBER________________________________ DATE______________________________

NAME____

LINE #	DIRECTION	FROM	TO	ID	COMMENT

TYPES DATA FORM

(for windows and doors)

BUILDING I.D. NUMBER________________________ DATE________________________

NAME________________________

LINE	ID	HEIGHT(m)	WIDTH(m)	DISTANCE ABOVE FLOOR	THICKNESS(cm)	LAYER MATERIAL	FRAME MATERIAL

NBS-114A (REV. 2-80)

U.S. DEPT. OF COMM. **BIBLIOGRAPHIC DATA SHEET** *(See instructions)*	1. PUBLICATION OR REPORT NO. NBSIR 84-3009	2. Performing Organ. Report No.	3. Publication Date September 1984

4. TITLE AND SUBTITLE

BUILDING PENETRATION PROJECT

5. AUTHOR(S)

J. C. Wyss, W. J. Anson, R. D. Orr

6. PERFORMING ORGANIZATION *(If joint or other than NBS, see instructions)*

NATIONAL BUREAU OF STANDARDS
DEPARTMENT OF COMMERCE
WASHINGTON, D.C. 20234

7. Contract/Grant No.

8. Type of Report & Period Covered

9. SPONSORING ORGANIZATION NAME AND COMPLETE ADDRESS *(Street, City, State, ZIP)*

Communications Electronics Engineering Installation Agency
Fort Huachuca, Arizona 08613

10. SUPPLEMENTARY NOTES

☐ Document describes a computer program; SF-185, FIPS Software Summary, is attached.

11. ABSTRACT *(A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here)*

This report documents a computer program which calculates building attenuation of electromagnetic radiation over the frequency range 10 kHz - 10 GHz. Attenuation (in dB) is computed from building shape, dimensions, room layout, and the electrical properties of construction materials; no electromagnetic measurements are required. Details of the structure and use of the program are given.

12. KEY WORDS *(Six to twelve entries; alphabetical order; capitalize only proper names; and separate key words by semicolons)*

computer model; electromagnetic attenuation; electromagnetic interference; electromagnetic shielding; shielding materials

13. AVAILABILITY

[X] Unlimited
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